UGANDA PROTECTORATE.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

YEAR ENDED 31ST DECEMBER, 1933.

(PART II).

PRICE: SHS. 4/-.

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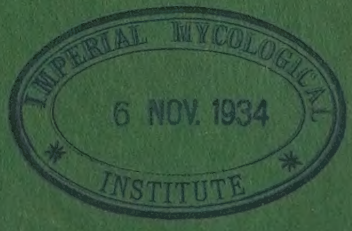

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CONTENTS.

	PAGE.
Annual Report of the Experimental Work Done in the Eastern Division ...	3—8
Report on the Bukalasa Experiment Station	9—14
Report of the Botanical Section	15—44
Report of the Government Entomologist	45—48
Report of the Mycologist	48—51
Appendix :— Blackarm Research	52—59
Report of the Agricultural Chemist	60—65
Report on the Kampala Plantation	66—68

ANNUAL REPORT ON THE EXPERIMENTAL WORK DONE IN THE EASTERN DIVISION.

This report gives an account of the experimental work carried out at the Serere Experiment Station, the Bugusege Plantation, and the farms at Ngetta and Wanyange.

The Kamuge farm was closed down but it is to be replaced by a new farm, on which clearing has commenced, near to Mbale. Complementary experiments were done in Lango and Teso districts.

Messrs. D. Stedman Davies and N. S. Haig acted as Senior Agricultural Officer successively during the period under review and were in charge of the work, the writer being absent from this division for the whole year.

The report is divided into four sections:—

SECTION I—GROUNDNUTS.
SECTION II—COTTON.
SECTION III—COFFEE.
SECTION IV—OTHER CROPS.

SECTION I—GROUNDNUTS.

Spacing, Mulching, and Variety Trials.

(1) *Object.*—To ascertain the optimum spacing for two varieties, to compare the yields of these varieties, and to determine whether mulching is beneficial.

The treatments were as follows:—

Varieties 2, Bunch and Spreading.
Spacings 3, 2 ft. by 1 ft., 1 ft. by 1 ft., and 9 ins. by 9 ins.
Mulch and no mulch.

Lay-out.—Six randomised blocks, each divided at random into two sub-blocks equivalent to the two varieties. Each varietal sub-block was divided at random into six combined treatments of spacing, mulched, and unmulched. This was done at Serere.

Results.—(*a*) The yields of shelled nuts showed that in this experiment the spreading groundnut yielded much better than the bunch. This is contrary to previous experience and the reason was probably the abnormally dry weather during the ripening period of the bunch groundnuts.

Mulching increased the yield of the spreading variety but had little effect on the bunch.

The 2 ft. by 1 ft. spacing gave smaller yields than the other spacings. There was no significant difference between the smaller spacings.

(*b*) The results were also worked out on the yields over the amount of seed used for planting. The same general conclusions were reached.

(*c*) *Rosette Disease.*—A count of the number of plants infected with rosette disease showed that the 2 ft. by 1 ft. plots were more heavily infected than the closer spacings. At the wide spacing, the mulch reduced the percentage infection among the bunch groundnuts.

(2) *Object.*—Similar experiments were done at Ngetta and Wanyange with the same objects of testing the two types of groundnut, mulching, and spacing. The spacings adopted were 1 ft. by 1 ft. and 9 ins. by 9 ins. only.

Results.—The Wanyange figures were found to be unreliable and the bunch plots at Ngetta were attacked by locust hoppers. In the Ngetta trial, however, the two types yielded equally well. The 9 ins. by 9 ins. spacing gave the best yield. Mulched and control plots were not significantly different.

Groundnut Close Spacing Experiment.

Object.—To compare still closer spacings for both types of groundnut, since previous trials have shown that the optimum spacing has not yet been determined. The spacings were 1 ft. by 6 ins. and 6 ins. by 6 ins.

Lay-out.—A modified half drill strip method was used, separate experiments being put down for bunch and for spreading groundnuts. This was done at Serere and Ngetta.

Results.—Ngetta bunch groundnuts were eaten by locusts. At Serere where the results were worked out on the net yields (subtracting the weight of seed sown) there was no difference between the two spacings.

As regards the spreading type the wider spacing was very significantly better than 6 ins. by 6 ins. but no difference could be shown at Ngetta.

SECTION II.—COTTON.

Sowing Date and Spacing Trial.

(1) *Object.*—While the optimum sowing date and spacing for most areas has been determined by experiment, the best spacing for late planted cotton has not yet been ascertained. There will always be a considerable proportion of late cotton planted after the harvest of the grain crop. It is required to know whether the low yield of late planted cotton could be improved by closer spacing.

Lay-out.—A 3 by 3 Latin square of sowing dates, each sowing date being sub-divided at random into three spacings. The plots were 27 ft. by 28 ft., adjusted by cutting out the right number of plants to give the same effective acreage in each plot.

The experiment was done at Serere, Ngetta, and Wanyange.

Spacings at the two former places were:—

3 ft. by 1 ft.
3 ft. by 6 ins.
3 ft. by 3 ins.

and at Wanyange 3 ft. by 2 ft., 3 ft. by 1 ft. and 3 ft. by 6 ins. The sowing dates were as near as possible, having regard to the weather conditions, to the middle of

May,
June,
July,

except that at Wanyange June, July, and August were used.

Results.—The differences in the yields given by plots of different spacings were not significant although at each centre the closest spacings gave the lowest yield.

As regards sowing date the results agreed with those of previous years. The earlier dates gave the highest yield.

There was no interaction between Sowing Dates and Spacings.

The experiment will be repeated.

(2) *Object.*—To determine whether very early plantings give better yields in Usuku county of Teso District.

Lay-out.—A 4 by 4 Latin square, sub-plots being 27 ft. by 27 ft., cotton being spaced at 3 ft. by 1 ft., and the sowing dates being

Mid April,
Mid May,
Mid June,
Mid July,

This experiment was done at Katakwi and Toroma.

Results.—The mean yields of the two trials combined are given in the following table:—

Date Planted.	*Total Yields in Ounces.*
April	1,208
May	758
June	651
July	327

In the statistical treatment of these results the April figures are shown to be significantly greater than the other three sowing dates.

Cotton Cultivation Experiment.

Object.—To test the growing of cotton on mounds and ridges in Usuku county of Teso district where root growth is apt to be restricted owing to the nature of the soil.

Lay-out.—A 4 by 4 Latin square of the following treatments:—

Large mounds made from 4 ft. square, 5 plants per mound.
Small mounds ,, ,, 3 ft. ,, , 3 ,, ,, ,,
Ridges ... ... 4 ft. apart, 48 ,, ,, ridge.
Control (flat) ... ... 36 ,, per row.

All plots May planted. The experiment was done at Katakwi and Toroma.

Results.—The yields gave no indication that ridge or mound cultivation is any improvement on flat cultivation.

Break Pan Experiment.

Object.—To ascertain whether, by growing a crop of Kapenda (*Cajanus indicus*) before cotton, the pan which forms in the soil of Usuku county can be sufficiently broken up to allow of extra root room for the cotton, and in consequence an improvement of yield.

Lay-out.—Five pairs of plots. One of each pair under Cajanus and the other under cow pea (the latter is merely to keep the ground covered). The Cajanus is to be uprooted in 1934 and a cotton crop is to be taken. The experiment is being carried out at Katakwi and Toroma.

Cotton and Groundnuts Interplanting Experiment.

Object.—To find the effect of growing groundnuts between the rows of cotton and to determine whether the combined returns from both crops would make interplanting worth while.

To compare the bunch and the spreading types of groundnut for this purpose, and to try various combinations of spacings.

Lay-out.—Two separate experiments of 40 plots each for the bunch and spreading types of groundnuts. Each experiment had the same 8 spacing treatments replicated in 5 blocks.

Treatments.—

1. Cotton alone 3 ft. by 1 ft.
2. Groundnuts alone 9 ins. by 9 ins.
3. Cotton 3 ft. by 1 ft. and 1 row groundnuts.
4. ,, 3 ft. ,, 1 ft. ,, 2 rows ,,
5. ,, 4 ft. ,, 1 ft. ,, 3 ,, ,,
6. ,, 4 ft. ,, 1 ft. ,, 4 ,, ,,
7. ,, 6 ft. ,, 1 ft. ,, 6 ,, ,,
8. ,, 6 ft. ,, 1 ft. ,, 7 ,, ,,

The plots were 30 ft. by 36 ft.

The experiment was done at Ngetta and Kaberamaido.

Cotton was planted in mid-June at Ngetta and mid-July at Kaberamaido.

In both cases groundnuts were put in a fortnight later.

Results.—The results have been computed as cash returns with cotton priced at 9 cents per lb., and unshelled groundnuts at 2½ cents per lb. They are expressed in two ways: (*a*) as net returns after deducting the value of the groundnut seed planted, (*b*) as gross returns. The total returns from the ten plots of each treatment in the two experiments combined, on which the statistics were worked out, and the calculated yields per acre are given in the following table:—

TREATMENT.	TOTAL NET RETURNS OF PLOTS.		RETURN PER ACRE.			
	Cotton and Bunch Groundnuts.	Cotton and Spreading Groundnuts.	Cotton and Bunch Groundnuts.		Cotton and Spreading Groundnuts.	
			Net	Gross	Net	Gross
	Cents.	Cents.	Shs. cts.	Shs. cts.	Shs. cts.	Shs. cts.
1. Cotton alone 3 ft. by 1 ft.	931·5	751·5	37 26	37 26	30 06	30 06
2. Groundnuts alone 9 ft. by 9 ft.	578·5	497·5	23 14	25 74	19 90	22 50
3. Cotton 3 ft. by 1 ft. and 1 row groundnuts ...	1164·0	568·0	46 56	47 16	22 72	23 32
4. Cotton 3 ft. by 1 ft. and 2 rows groundnuts ...	1068·0	553·0	41 92	44 12	22 14	23 54
5. Cotton 4 ft. by 1 ft. and 3 rows groundnuts ...	1135·0	581·0	45 40	46 80	23 24	24 64
6. Cotton 4 ft. by 1 ft. and 4 rows groundnuts ...	1153·5	624·0	46 14	48 14	24 98	26 98
7. Cotton 6 ft. by 1 ft. and 6 rows groundnuts ...	1029·5	577·0	41 18	43 18	23 08	25 08
8. Cotton 6 ft. by 1 ft. and 7 rows groundnuts ...	1045·5	678·0	41 82	44 22	27 12	29 52

The spreading groundnuts depressed the yield of cotton in every case and the best money return was derived from cotton.

On the other hand interplanting bunch groundnuts gave a higher return than either cotton or groundnuts grown singly.

In the Ngetta experiment statistical treatment of the yield figures showed that one row of bunch groundnuts in 3 ft. by 1 ft. cotton had little effect on the yield of cotton but that two rows of groundnuts made a significant depression.

The experiment is being repeated using an earlier sowing date.

Observation plots containing cotton, and cotton interplanted with both types of groundnut were put down at ten centres in Lango. The general conclusions supported those recorded above.

Cotton Variety Trials.

These were conducted by the Assistant Botanist at Serere, and by Agricultural Officers in the districts. They are described in the report of the Botanical Section.

Dusting and Variety Trial.

These experiments to determine the effect of dusting as a control for blackarm disease were done at Serere, Ngetta and Wanyange. Details will be found in the report of the Mycologist.

SECTION III.—COFFEE.

Bugusege Experiments (Arabica Coffee).

(1) Pruning Experiment.

Object.—To compare the yield obtained from Single Stem, Multiple Stem, and Agobiada pruning systems.

Lay-out.—Eight randomised blocks, the sub-plots containing 7 rows of 8 trees, spaced 8 ft. by 8 ft.

Results.—Agobiada has given the highest yields over the five seasons 1929—1933.

Thus:—

	Total Yield of Cherry.
Agobiada	21,869 lbs.
Multiple Stem	15,868 lbs.
Single Stem	10,618 lbs.

The order of superiority with P=0·01 is:—

Agobiada significantly better than Multiple Stem.
Multiple Stem significantly better than Single Stem.

The trend of the experiment in the 1933 crop, taking the year's results by themselves, indicates a reversal of the relative position of the Agobiada and Multiple Stem treatments.

	1933 Yields of Cherry.
Agobiada	4,287 lbs.
Multiple Stem	4,778 lbs.
Single Stem	576 lbs.

The difference is, however, not significant.

The low yield of the single stem treatment has been caused partly by the death of trees from die-back after overbearing.

(2) Pruning Experiment.

Object.—To test a simple form of multiple stem pruning which may be suitable for natives to use, against natural growth and Agobiada.

Lay-out.—The experiment was planted in 1930. The first considerable crop was borne this year and the results to date are as follows:—

	Total Yields of Cherry in lbs.
Modified Multiple Stem	2,095
Natural Growth	1,435
Agobiada	929

No importance can be attached to the first year's results.

(3) Manuring Experiment.

Object.—To compare the yields from coffee manured in the following ways:—

(*a*) Clean weeded.
(*b*) Green manure—two covers per annum.
(*c*) Banana leaf mulch.
(*d*) Ordinary weed cover.
(*e*) Leguminous cover crop from October to March and clean weeded for the rest of the year.

Lay-out.—A 5 by 5 Latin square, each sub-plot containing 5 rows of 8 trees spaced 8 ft. by 8 ft. The trees are pruned on the single stem system modified with a view to the prevention of die back by allowing unlimited terminal growth.

Results.—The experiment was planted in 1928. The yields to date in lbs. of cherry, are as follows:—

	Total.	*1933 Crop.*
(*a*) Clean weeded	7,118	2,789
(*b*) Two Cover crops a year ...	5,914	1,702
(*c*) Banana leaf mulch	6,757	1,988
(*d*) Weed cover	5,213	1,909
(*e*) October—March cover ...	7,352	2,290

In the first crop the weed cover (*d*) gave the best yield though not significantly so. In the second crop weed cover (*d*) was significantly worst and two cover crops a year was second worst, there being no significant differences between the other treatments. Since the second year these results have confirmed themselves as regards the inferiority of the weed cover and two-cover treatments.

The October—March cover (*e*) in the total yields is significantly better than all others, but the 1933 crop figures show a significant superiority of the clean weeded treatment.

(4) New Experiments.

Of the other four experiments at Bugusege, *viz.*:—

(*a*) 1932 Planted Cultural Experiment,
(*b*) ,, Spacing Experiment,
(*c*) ,, Shade Experiment,
(*d*) ,, Single Tree Yield,

the trees have not yet come into bearing. A description of the lay-out of these experiments appears in the Annual Report, Part II, for 1932.

Robusta Coffee Trials.

Efforts are being made to interest the native population of Busoga in Robusta coffee and nurseries have been laid down to provide trees for distribution. At the same time a number of selections of Robusta coffee made by the Botanical Section are being grown for observation at Wanyange.

SECTION IV.—OTHER CROPS.

1. Cassava.

(*a*) A block of this crop was planted at Ngetta. Strips will be harvested at two-monthly intervals in order to determine the best length of time to leave the roots in the ground.

(*b*) A small collection of varieties was planted at Wanyange.

(*c*) At Serere the following varieties, planted at 4 ft. by 4 ft. spacing, are kept for observation—Bitajuma, Nyumbezunga, Nakacacali, Lulanda, Nakitembe, Bitamisi, Mukedi, Red Jacket, Bunch of keys, Smalling, Grey Hound, and Bobby Hanson.

2. Bulo (Eleusine).

Work with this crop has again been hindered by the attacks of locust which again destroyed the eleven varieties planted at Ngetta. At Serere a 10-acre block was sown with stock seed to provide material for selection work.

3. Plantains.

Sixteen varieties of plantains have been planted at Wanyange for observation.

4. Grasses and Grazing Plants.

The observations on grasses at Ngetta were continued. Strips of the following grasses were laid down:—

(*a*) *Brachiaria decumbens.*—This remained fresh and green throughout the dry season. It is much liked by cattle.

(*b*) *Cynodon dactylon*, a useful bottom grass but produces but little grazing in the dry season.

(*c*) *Penesetum polystachyon* is readily eaten by cattle. It produces a good bulk during the rains but not much in dry weather.

(*d*) *Penesetum unisetum*, coarse and tufted, very palatable, but does not withstand very dry conditions.

(*e*) *Panicum maximum*, continues to do well.

(*f*) *Setaria spacelata*, less tufted than some other top grasses. It is fairly palatable and drought resistant.

(*g*) *Mixed Grasses.*—This strip contains the six grasses mentioned above.

(*h*) *Lucerne.*—Two acres of lucerne were planted. The cattle have become very fond of this crop and have grazed it severely. When the seed was planted soil sent with the seed from Naivasha in Kenya was mixed with it. Good nodule formation has resulted.

(*i*) The grasses *Hyparrhenia* and *Sporobolus pyramidalis* died out during the dry season.

(*j*) *Indigophora endecaphylla* formed a good cover. Cattle grazed it readily.

5. Sweet Potatoes.

(1) Cultivation Trial.

Object.—To test four methods of growing sweet potatoes:—

(*a*) On heaps 4 ft. by 4 ft.
(*b*) On ridges made by hand 3 ft. apart.
(*c*) On heaps 2 ft. by 2 ft.
(*d*) On ridges ploughed 2 ft. apart.

Lay-out.—Six randomised blocks of the four treatments. Each plot was 30 yds. by 8 yds. or about 1/30th acre. The experiment was done at Ngetta.

Results.—The crop was planted on September 20th and was harvested, in the dry season, on February 12th.

The yields were as follows:—

	Mean yield per plot. lbs.	*Per acre.* lbs.
Heaps, 4 ft. by 4 ft.	221	6,630
Ridges, 3 ft., by hand	216	6,480
Heaps, 2 ft. by 2 ft.	216	6,480
Ridges Ploughed 2 ft. apart ...	196	5,880

These results were not significant. They agree with those of the previous year in showing a small advantage to be attached to growing the crop on large mounds.

(2) Varieties.

A collection of Busoga sweet potato varieties has been started on the Wanyange Farm.

6. Manurial Experiment.

Object.—To compare varying amounts of Farmyard Manure, Green Manure, and Green Manure and Lime, as a measure for the retention of fertility.

Lay-out.—A 5 by 5 Latin square of the following treatments:—

(1) Green manure.
(2) Lime 2 tons per acre, and green manure.
(3) Farmyard manure, 10 tons per acre, and green manure.
(4) ,, ,, 20 ,, ,, ,, ,, ,, ,,
(5) ,, ,, 30 ,, ,, ,, ,, ,, ,,

The green manure is *Crotalaria juncea* sown at 80 lbs. seed per acre.

The rotation used is a normal one used in Teso district:—

1st Year—Cotton.
2nd Year—Bulo (Eleusine).
3rd Year—Groundnuts.

The manure and green manure come before cotton and after groundnuts. The experiment was carried out at Serere.

Results.—One crop only has been taken. It will be necessary to complete one or more cycles of the rotation before attempting to draw any conclusions.

7. Rotation Experiment and Erosion Experiment.

A description of these experiments was given in the Annual Report Part II for 1930. These are both long term experiments which have not yet reached the stage at which conclusions may be drawn.

8. Cover Crops.

Plots of green manures and cover crops were maintained including Venezuelan Soy Bean, *Tephrosia candida, T. Vogelii, Phaseolus calcaratus,* Buckwheat, *Stizolobium, Crotalaria striata, C. spectabilis, Indigophora endecaphylla, Indigophora arrecta, Clitoria cajanifolia, Centrosema pubescens, C. plumerei, Dolichos lablab,* and *D. Hosei.*

9. Nursery at Serere.

Seed of Tung Oil, received from Kew, has been planted. A large number of fruit trees were issued to residents, and a quantity of mango seed was supplied to the Forest Department.

Conclusion.

The mathematical work on the results remains on record for use when each experiment has been repeated and brought to a conclusion. In the meantime it has been decided to omit a great deal of the statistical detail and the present account of the experiments in the Eastern Division may be regarded largely as a progress report.

C. E. J. BIGGS,

Senior Agricultural Officer, Eastern Division.

REPORT ON BUKALASA PLANTATION FOR YEAR 1933-34.

This report does not include the work of the Botanical and Education sections, which is submitted in the sectional reports.

Introduction.

The general rotation adopted for the experimental area was changed in order to include a resting period of three years under elephant grass. The rotation is now as follows:—

1st year	Cotton.
2nd year	Foodcrops, tobacco, etc.
	Sweet potatoes.
3rd year	Sweet potatoes.
	Cotton.
4th year	Elephant grass planted.
5th and 6th years ...	Elephant grass.

This rotation is a modification of the native practice, and it is hoped that planting elephant grass and leaving it for three years will be equivalent to the native practice of allowing the elephant grass to come in on its own, which takes approximately three years, and then leaving the land for another three years before cultivating it again.

Practically all the land under cultivation on the Plantation received a dressing of cotton seed at the rate of 3—4 tons per acre. This was undoubtedly in no small way responsible for the high yields of cotton which were obtained.

A mosquito survey of the Plantation was carried out by the Entomological Section and a number of breeding places of Anopheles spp. were found. Anti-malarial measures have been taken including filling up of redundant water-holes, soil pits, etc., and also of planting eucalyptus trees in the swampy areas.

In connection with the anti-mosquito work a small swamp on the plantation has been canalised. This has been most successful in draining a very wet area which it is hoped will be entirely reclaimed in the course of a few years.

The water problem became acute in the prolonged dry period from December to March. All water holes dried up and the well was practically exhausted. Had it not been for the canalisation of the swamp, which gave water in limited quantities, the whole of the coffee and tobacco nurseries would have had to have been abandoned.

Much work has been done in connection with anti-erosion measures, the chief agents used being lines of lemon grass and small reed fencelets constructed across the main lines of flow. It is hoped that by the end of 1934, erosion will be completely checked on the plantation.

The purchase of 98 acres of land was completed in October, 1933. Of this area, 36 acres are required for cotton increase purposes, and the remainder, necessary as a quarantine belt, will be used for coffee, tobacco and other experiments. Clearing of this area has commenced, and 18 acres will be under cotton in 1934.

Meteorology.

The weather of the season was definitely dry, the worst periods in this respect being June and July, which hindered cotton planting, and an unusually prolonged period from December onwards which suppressed any second picking peak.

The remainder of the season was satisfactory except that hail occured three times, ruining the first tobacco breeding plot and badly damaging cotton—fortunately when it was young and above to recover.

A. Cotton.

(*a*) General.

The effect of the dry weather experienced in the latter part of the season was seen in the rapid ripening of the crop giving a steep single-peaked picking curve, the latter part of which contained much immature cotton.

The average yield from Blocks B, C and E was 750 lbs. seed cotton per acre—the highest average yield recorded at Bukalasa. This high yield was in no small part due to the dressing of cotton seed which all the land received.

Blackarm was never very widespread and insect damage was confined to Lygus and Bollworm. Lygus was very severe on individual plants. Stainers only became evident at the tail end of the season and then only on a single isolated plot.

The percentage of stained cotton was very low and practically no rain-stained cotton was harvested, the general grade of the crop being excellent.

(*b*) Experimental.

(1) *Tractor cultivation versus Native hoeing* combined with a test of 4 ft. by 1½ ft. (Control) spacing against 3 ft. by 1 ft.

No differences in yield were obtained between the methods of cultivation, but close spacing gave a significant increase over control.

TABLE I.

Spacing.	Mean yield per plot.	Yield per acre.
4 ft. by 1½ ft.	77·2	772
3 ft. by 1 ft.	95·2	952
S.E. Difference	2·92	...

(2) *Mulching Late Sown Cotton.*—This experiment was continued, and mulching again gave a significant increase over control. The high cost of mulching (over Shs. 65 per acre) however, more than counterbalanced the value of the increased yield, despite the fact that the cost of weeding was less.

TABLE II.

	Mean yield per plot. *lbs.*	Mean yield per acre.	Value of crop per acre. *Shs.* *cts.*
Mulched	48·5	873	98 52
Control	40·6	731	80 42

(3) *Inter-planting and Spacing.*—This experiment was repeated on slightly modified lines, and apart from showing a significant decrease in yield due to wide spacing no results were obtained. The widespread local practice of interplanting in Buganda appears to have no deleterious effect on the cotton crop provided planting is done at the proper time. On the contrary, the gross return per acre is greater with inter-planted cotton.

The question of a residual effect and possible hastening of soil exhaustion in the inter-planted plots will need to be considered, and it is hoped to start an investigation next season.

Results.—

TABLE III.

Treatment.	*Cotton* Mean yield per plot (1/32 acre). *lbs.*	*Goundnuts.* Mean yield per plot. (1/32 acre.) *lbs.*	Equivalent to gross return per acre of Shs. Cts.
Control (4 ft. by 1½ ft.)	25·5	...	91 00
„ (5 ft. by 2 ft.)	20·9	...	75 00
Interplanted Groundnuts (4 ft. by 1½ ft.)	22·7	13·4	99 00
„ „ (5 ft. by 2 ft.)	19·3	12·0	89 00
„ Mutike (4 ft. by 1½ ft.)	23·4	16(Mutike)	...
S.E. Difference	1·65	...	...

(4) *Two plants per hole against one.*—The results obtained show no significance, which is possibly in part due to the fact that there were many "singles" in the two per hole plots.

The fertility gradient on the block was very marked indeed.

(5) *Topping.*—An experiment to test the effect on habit and final yield of topping the plants was started, but owing to a severe hail storm which successfully topped over 50 per cent. of the control plants no results were obtained.

(6) *Time of Singling.*—A test of early and late singling was made—no differences in final yields between treatments were obtained. Here again the fertility gradient was very marked.

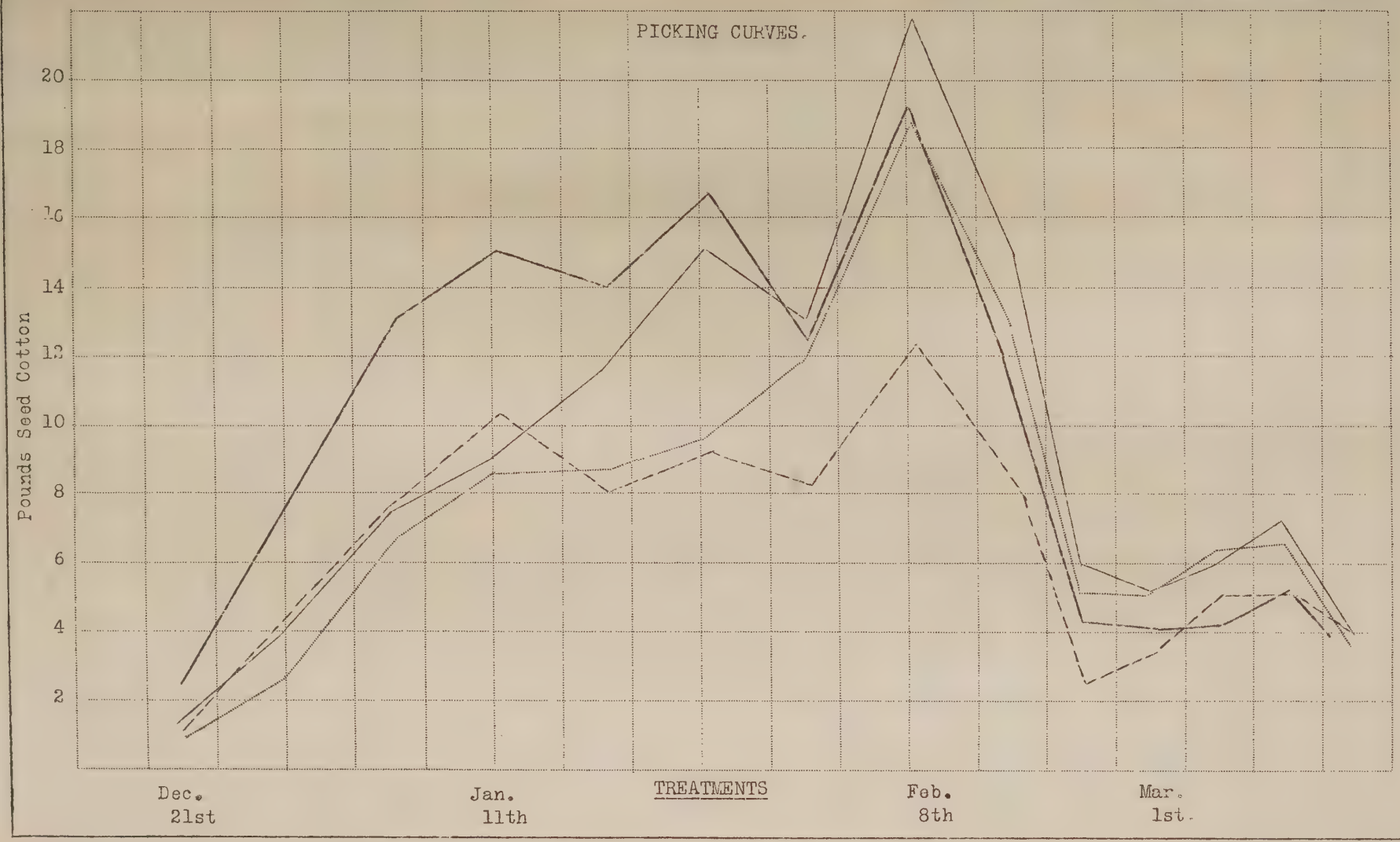
(7) *Manurial Experiment.*—A first trial was made of the effect of green manure and of cotton seed on the following cotton crop. Lay-out 4 ft. by 4 ft. Latin square with the following treatments:—

1. Control.
2. Cotton seed @ 5 tons per acre.
3. Green manure (*Crotalaria Juncea*).
4. Cotton seed @ 2½ tons combined with green manure. (*C. juncea*).

The results of the first season are very interesting, the effect of cotton seed being most marked while that of green manure was slight, if any. The outstanding effect of cotton seed

MANURIAL EXPERIMENT

Bukalasa Plantation



Cotton Seed with green manure (4)

Green Manure (3)

Cotton Seed (2)

Control (1)

was to hasten maturity considerably, and it is interesting in this connection to observe that in Treatment 4 the effect of green manure was to depress the early maturing effect of the cotton seed.

The green manure plots matured later than any of the others.

The results of the first year are tabulated below:—

TABLE IV.

Treatment.	Yield per plot. *lbs.*	Yield as percentage of mean.	Percentage of Fifi.	Yield per acre.
1	22·5	77·4	12·7	812
2	33·6	115·1	11·4	1,220
3	27·4	94·0	10·3	987
4	32·9	113·1	8·9	1,182
Mean	29·1	100·0	...	1050·2
S.E. Difference ...	3·02	10·4	...	...

Cotton seed gives a significant increase in yield over control, and green manure; cotton seed combined with green manure gives a significant increase over control.

This experiment is being carried on over a period of years; the residual value of the manurial treatments will be tested with a crop of groundnuts in the spring of 1934.

B. Groundnuts.

(1) *Rosette Disease Experiment.*—This was repeated in the Spring and Autumn rains, with some modifications of the previous years treatments.

(*a*) *Spring Sown.*—

Lay-out—5 ft. by 5 ft. Latin square. Plots 1/27th-acre.

Treatments.—

A. Spaced 1 ft. by 1 ft., clean weeded.
B. ,, 2 ft. by 2 ft., ,, ,,
C. ,, ,, ,, weeded half as often as A and B.
D. ,, ,, ,, mulched at germination.
E. ,, ,, ,, mulched two months after germination.

TABLE V.

Results.—

Spring Sown.	Treatments. *A*	*B*	*C*	*D*	*E*	*Mean.*	*S.E. Diff.*
Mean yield per plot (lbs.) ...	95·2	66·0	29·2	55·2	59·0	60·9	7·8
Percentage of Mean ...	156	108	48	91	97	100	11·3

The incidence of Rosette was so slight that no differences in incidence between treatments were observed. On the other hand, however, the results confirm previous ones in that close spacing, *i.e.*, 1 ft. by 1 ft., gives a significant increase in yield over the wider spacing, and all treatments yielded significantly better than Treatment C.

(2) *Autumn Sown.*—Lay-out and area similar to Spring sowing. Treatments as follows:—

A. 1 ft. by 1 ft.
B. 1 ft. by 1 ft., mulched at germination.
C. 1 ft. by 1 ft., weeded half as often as A.
D. 2 ft. by 2 ft., mulched at germination.
E. 2 ft. by 2 ft., mulched two months after germination.

Results.—

TABLE VI.

	A	*B*	*C*	*D*	*E*	*Mean.*	*S.E. Diff.*
Mean yield per plot (lbs.) ...	61·0	66·8	58·2	38·4	35·2	51·9	4·64
Yield as percentage of Mean ...	118	128	112	74	68	10·0	8·9

The figures show significance when P=0·01.

Spacing 1 ft. by 1 ft. again shows superiority in yield over 2 ft. by 2 ft. irrespective of ground treatment. Mulching appears to have no effect on yield.

The Rosette infection figures were again too low to give much indication, but the table below does show that close spacing assists considerably in the reduction of the incidence of the disease.

TABLE VII.

	A	*B*	*C*	*D*	*E*
Percentage of plants infected with Rosette ...	0·72	1·97	0·66	4·60	4·30

Summary of Rosette Results.—The results of this year confirm those obtained previously which may be summarised as follows—

Spacing at 1 ft. by 1 ft. gives a definite increase in yield over 2 ft. by 2 ft. spacing, and also a definite reduction in incidence of Rosette disease. Mulching has apparently no beneficial effect, and being a costly operation as well it cannot under present circumstances be recommended for native practice.

(2) *Variety Trial* (*Spring sown*).—The following varieties were tested in a 5 ft. by 5 ft. Latin square:—

1. Bukalasa bunch.
2. Virginia bunch.
3. Philippine pink.
4. Basse.
5. H.G.1.

TABLE VIII.

Varieties.	Mean yield per plot (unshelled).	Yield per acre (unshelled).	Loss % in shelling.
		Lbs.	
3	71·6	2,864	31·6
2	68·2	2,728	28·1
4	68·0	2,720	26·9
5	58·6	2,344	38·7
1	57·2	2,288	26·6
S.E. Difference	2·21	...	...

Results.—Philippine Pink, Virginia bunch and *Basse* gave significantly better yields than either *Bukalasa Bunch* or *H.G.1.*

It is interesting that H.G.1. appeared to be more resistant to Rosette disease than the other varieties.

C. Coffee.

(1) *Shade and Cover Crop Experiment.*—The only alteration during the year was that half the shade was heavily cut back in July as the shade effect appeared to be excessive.

A very heavy crop indeed was harvested and the figures for the season are tabulated below:—

TABLE IX.—YIELDS IN LBS. WET CHERRY.

The figures in brackets are the total yields to date from this experiment.

	Glyricidia shade.	Banana shade.	No shade.	Totals.
Clean weeded ...	5,746 (9,784)	7,267 (11,165)	7,280 (12,287)	20,293 (33,236)
Permanent Cover crop	6,628 (9,303)	6,015 (8,087)	7,385 (10,121)	20,028 (27,511)
Totals ...	12,374 (19,087)	13,282 (19,252)	14,665 (22,408)	40,231 (60,747)

TABLE X.—FIGURES SHOWING MEAN PLOT ($\frac{1}{6}$th-acre) YIELDS IN LBS. WET CHERRY.

Shade.	Ground Treatment.	Mean Plot Yield.	Yield as Percentage of Mean.
Glyricidia shade	Cover crop	1550·5	92
	Clean weeded	1630·7	96
Banana shade	Cover crop	1347·8	79
	Clean weeded	1860·8	110
No shade	Cover crop	1686·8	100
	Clean weeded	2047·8	121
	S.E. Difference	96·7	5·7
	Mean	1690	100

The results are significant when P=0·01 and may be summarised as follows:—

Clean Weeding still shows a very significant increase in yield over *Cover Crop* irrespective of shade.

No Shade shows a significant increase over both *Glyricidia* and *Banana Shades* irrespective of Ground Treatment.

There is no difference between Banana and *Glyricidia* shade.

It is interesting that in the *Glyricidia* shade plots there is no difference between Cover Crop and Clean Weeding, whereas in the other treatments the differences are very marked.

The figures from 1933-34 season show some changes from the previous season—the reaction to the Cover Crop is noteworthy—both No Shade and *Glyricidia* Shade have benefited by a Cover Crop whereas the reverse is the case under Banana Shade.

(2) *Ground Treatment Experiment.*—Treatments as follows:—

1. Clean weeded.
2. Mulched.
3. Permanent cover.
4. Selective weeding (grasses removed).

No crop has yet been taken.

General.

(1) *Cover Crops, etc.*—The following Cover Crops and Green Manures were grown for observation and increase—

Stizolobium, Cassia, Indigofera anil, Cajanus indicus, Sesbania, Crotalaria juncea, C. alata, C. agatiflora, C. Natalita, Dolichos Lablab, Phaseolus calcaratus, Centrosema plumieri and *pubescens*, Witch pea, various types of native beans, etc.

Stocks of varieties of Cassava and Sweet Potatoes were maintained.

(2) *New Introductions.*—The following plants were grown for the first time (as far as can be ascertained) at Bukalasa—Tara Beans, Pecan Nuts, Sisal, Nganda Coffee, *Phaseolus lunatus* (Madagascar Bean).

(3) *Labour.*—The supply of labour always exceeded the demand. The number resident at any one time averaged 150.

The general health was good, but it is regrettable that one headman died of plague on the plantation.

(4) *Asclepias semi-lunata.*—An acre plot was planted up to obtain a fairly large sample for report. Difficulties in harvesting and cleaning the fibre were so great that only a very small clean sample was obtained.

Model Shamba (commenced 1927).

A very satisfactory tenant has been found for this shamba. He and his wife have run the whole area except for digging in the green manure when he had to employ labour. The yields have shown a decided drop despite a much higher standard of cultivation as compared with previous years. The yields of the main crops were as follows:—

TABLE XI.

Crop.	Mean yield per acre. *lbs.*	Increase or decrease on previous years.
Cotton	305	−109
Groundnuts	726	+388
Maize	821	−1679
Simsim	48	−32

The decrease in the yield of cotton is noteworthy as the remainder of the cotton at Bukalasa gave practically double the yield of the previous year, even where no cotton seed was applied. The reduction in maize yield is in part due to the fact that a considerable quantity was stolen off the plot.

The returns for the year are as follows:—

		Shs.	*Cts.*
Cotton	422 lbs. A. quality @ 12 cents	50	64
	35 lbs. B. quality @ 5 cents	1	75
Maize	821 lbs. @ 2 cents	16	42
Groundnuts ...	363 lbs. @ 5 cents	18	15
Simsim	24 lbs. @ 5 cents	1	20
	TOTAL	88	16

From this total a sum of Shs. 2/64 has to be deducted for extra labour employed, *i.e.*, 8 men-days @ 33 cents, leaving a balance of Shs. 85/52.

A. B. KILLICK,
Senior Agricultural Officer.

G. W. NYE,
Senior Botanist.

ANNUAL REPORT OF BOTANICAL SECTION, 1933-34.

Part I. Introduction.
,, II. Botanical Work at Bukalasa.
,, III. Botanical Work at Serere.
,, IV. Botanical Work at Kampala.
,, V. Botanic Gardens, Entebbe.

PART I.—INTRODUCTION.

Cotton.

Progress in the breeding work continues to be slow, but definite progress can be reported in the improvement of U. 4 derivatives at Serere. These have up to the present yielded much better than any existing types but the style of lint has been quite different and would be classed in a different category to the present "Uganda" type. It is now reported that one or two of the later generations grown at Serere are giving lint very nearly equal to that of S.G. 29. Great care will be taken to make sure of a good and permanent market before any new variety with a different type of lint is put into distribution. As in previous years the U. 4 types have done badly under Buganda conditions both in yield and in quality. In Buganda S.G. 23/8 still remains the most promising strain on account of its very distinct superiority over Local in spinning. Several new types in the Pedigree Lines indicate a superiority over Local as regards yield, quality and habit.

Work on Blackarm resistance has continued and at both Bukalasa and Serere distinctly resistant strains have been isolated. As these are not altogether satisfactory from other points of view crossing with other strains is being undertaken. The appearance of Fusarium Wilt in Buganda necessitates work on resistance.

A very useful elaboration of the purity target system of testing for purity of strains has been worked out and is proving of great assistance in recognising off types, etc.

Coffee.

Considerable progress has been made with selection of suitable Robusta and Nganda types. The Assistant Botanist was able to supply a quantity of mass selected seed for distribution in Buganda and Busoga.

Work on variation of bean weights and examination of produce from selected trees has given distinct indication of the possibilities of selection work in coffee.

Vegetative reproduction is still under trial but grafting is not likely to be so successful as was hoped. Further work on cuttings is being done.

Tea.

In view of the increasing importance of this crop and of the necessity for a local seed supply on account of restrictions on the export of tea seed, work has been done to improve existing tea seed gardens at Kampala, Buwunga and Kakumiro, and in addition the four new Jats are being planted out for seed purposes at widely separated centres. A tour of the Kericho tea area was carried out by the Senior Botanist in October.

Groundnuts.

Selection work has continued with special reference to Rosette disease. New importations are under trial.

Tobacco.

A start has been made with selection in tobacco at Bukalasa and Serere.

No curing was done at Serere—work being confined to selection of suitable mother plants from each of the imported varieties. Several of the Burley types were air cured at Bukalasa, the results of which were distinctly promising.

Other Crops.

Work has continued as in previous years on essential oils, simsim, ginger, fixed oils, cover crops and green manures, etc.

No striking progress is reported.

Acknowledgment.

This opportunity is taken to acknowledge the valuable assistance given by the Liverpool Uganda Co., in examining and reporting on large numbers of lint samples from Bukalasa and Serere.

PART II.—BOTANICAL WORK AT BUKALASA.

Meteorology.

The season under review was definitely a dry one, the total deviation from the 11-year average being a deficiency of 8·59 inches. May, June and July were abnormally dry and as a consequence cotton planting was seriously held up. Hand watering had to be resorted to on the cotton breeding plot. September was very wet and as a result Angular Leaf Spot spread rapidly. Fortunately the succeeding months were dry and the disease received a severe check, doing comparatively slight damage. The period from December to March was intensely dry and the result was a very rapid ripening of the cotton crop with a suppression of new growth and of the second flowering peak. Many of the later bolls opened prematurely and a high proportion of immature lint was harvested at that particular period. No second picking peak occurred.

Hail fell on three occasions and did considerable damage to the tobacco plots, cotton was also damaged but being young it was able to make a remarkable recovery.

It is interesting to note that one plot of the subsiduary cotton variety trial was struck by lightning, about 20 plants being killed.

As far as Bukalasa was concerned, the season was definitely favourable to cotton and higher yields were obtained than in the previous season. The dry and hot weather constituted a check to the spread of disease and of insect pests. It produced cotton which was rather shorter in staple than last season, but the percentage of stained seed cotton was very low indeed and the general grade was excellent.

The following table summarises the more important meteorological records of the season:—

TABLE I.—METEOROLOGICAL SUMMARY.

Month.	Rainfall.	Deviation from 11-year mean.	Daily Hours Sunshine.	Remarks.
1933:—				
April	6·79	−0·08	Unreliable	Unusually dry, 3·27 inches fell on 30th.
May	3·12	−1·78	4·9	Very dry from 15th onwards.
June	2·83	−0·76	4·8	Very dry. Early planting held up.
July	2·46	−1·31	5·0	No rain from 1st to 16th. Cotton planting delayed. Breeding plot hand watered. Hail on 27th.
August ...	6·57	+1·88	5·4	Dry until middle of month. Good rains later.
September ...	7·44	+2·35	5·4	Record total rain for September. Hail on 5th. Excellent weather for growth.
October	4·75	−2·40	5·6	Rains of September encouraged Angular Leaf Spot. Lowest total rains were recorded for October. Hail on 8th.
November ...	2·10	−2·22	5·7	Very dry. Good check to A.L.S. and Blackarm.
December ...	4·11	+1·10	6·1	No rain after 18th. Check to disease.
1934:—				
January ...	0·54	−1·13	6·5	Very dry. Rapid ripening.
February ...	0·41	−1·90	6·9	Very dry. Premature opening. Check to 2nd peak.
March	2·37	−2·44	6·2	
TOTAL ...	43·49	−8·69	..	

Cotton.

(1) Breeding Plot.

New Selections.—Over eighty single rows were planted early in July, consisting of about thirty entirely new selections, the remainder being made up of re-selections from the previous year. Among the new families no very promising material was obtained, in fact out of the thirty only two are being retained, one for drought resistance and the other for yield.

Re-selections from the B. 31 group continued to show very high resistance to Angular Leaf Spot and to early Blackarm but they appeared to be very susceptible to Fusarium Wilt which occurred in the breeding plot for the first time to a really serious extent.

The most promising group was a number of new selections from B. 37 families—plants in this group have nice erect habits and excellent lint, the average staple being 32 mm. They are not very resistant to Blackarm but at the same time appear able to tolerate it and to produce a good yield.

The early maturing B. 45 group did well and although the lint is on the short side it is of quite good quality.

U. 4 derivatives were again disappointing and the only one worth proceeding with is U. 4/B/12/5, a selection from the South Rhodesian U. 4/130.

Single plant selections were made in Native plots in the villages, a prize being given to the owner of the plant which had the greatest number of harvested bolls. The winning number was 232.

Pedigree Lines.

A total of 28 lines was grown several of which showed considerable promise. Those of the U. 4 group were again disappointing and although the plant habits were excellent and rate of flowering high the yields were mediocre and the lint poor. Of the lines of the B. 31 group B.P. 45/33 was the most promising but its resistance to Blackarm was not as high as the others, B.P. 46/33 being better in this respect. The two B. 37 lines did well although heavily infected with Blackarm. B.P. 50/33 was particularly promising as regards habit and yield and its percentage of sound to total locks was the highest recorded. In addition its lint length and ginning percentage were very satisfactory.

A re-selection from S.G. 23/8 (S.G. 23/8/6/13/10/7/12), B.P. 58/33, was distinctly promising as regards yield and appeared to be less susceptible to Blackarm than the original parent. It was rather late maturing but gave the highest yield of any of the pedigree lines. It also gave the lowest rate of boll shedding thus inheriting this character from its ancestor S.G. 23/8. Its ginning outturn is very good but the lint length is rather on the short side.

B.P. 59/33 is a brother of B.P. 58/33 but was quite different in several characters—its shedding rate was higher and its proportion of sound to total locks was the lowest of all the lines. On the other hand its staple was longer and ginning outturn lower than B.P. 58/33.

In the U. 4 group B.P. 63/33 is noticeable for its high rate of flowering coupled with a high rate of shedding, its lint is short and harsh. S.P. 48 yielded very well and gave a low rate of boll shedding; in addition it showed resistance to Angular Leaf Spot and Blackarm and had the excellent U. 4 habit—its lint, however, was much below standard.

S.P. 72 from Serere showed high resistance to Blackarm but was very late maturing and not very high yielding.

The two best lines, B.P. 50 and B.P. 58, will be increased next season and included in the variety trial.

The following tables summarise the quantitative characters of the most promising pedigrees:—

TABLE II.

Pedigree.	Mean flowers per plant.	Mean bolls per plant.	Shedding percentage.	Total sound locks per plant.	Percentage sound locks to total locks.
B.P. 46/33	65·0	20·4	68·5	67·2	78·8
B.P. 50/33	76·3	24·8	68·1	67·9	89·0
B.P. 52/33	74·3	25·5	65·6	78·3	76·5
B.P. 58/33	66·5	29·7	53·2	100·0	83·5
B.P. 59/33	65·6	24·6	62·5	48·4	47·5
B.P. 63/33	100·1	25·7	74·3	78·1	70·5
B.P. 68/33	68·4	20·3	70·3	63·8	75·1
S.P. 48	68·8	27·9	59·5	93·0	78·0
S.P. 72	62·0	22·6	63·4	73·9	80·6

TABLE III.

Pedigree.	Loculus No.	Weight seed cotton per boll. *grams.*	G.O.T.	Lint length. *mm.*	Origin.
B.P. 46/33	4·16	4·86	29·8	29·3	B. 31.
B.P. 50/33	3·98	5·05	31·4	31·9	B. 37.
B.P. 52/33	4·02	4·72	32·2	31·0	B. 42.
B.P. 58/33	4·04	5·00	32·6	29·4	S.G. 23/8.
B.P. 59/33	4·14	5·53	27·7	30·5	S.G. 23/8.
B.P. 63/33	4·35	4·65	34·4	27·8	U. 4/4/2.
B.P. 68/33	4·16	5·18	...	...	U. 4/4/2.
S.P. 48	4·26	4·94	36·8	28·3	U. 4/4/2.
S.P. 72	4·03	4·55	...	...	N. 17 Nariama

The three purity targets show the variation in purity of three Pedigree Lines—B.P. 52/33 shows up as being very uniform indeed for both lint length and ginning outturn while B.P. 58/33, although in its 8th generation, is very irregular for both characters but more especially for ginning outturn. The extreme dots are almost certainly off types. B.P. 50/33 has quite a good target, but there are obviously about four off type plants.

Reference Plot.

A collection of imported varieties, etc., including Delerect, Webber, Meade, Acala, Cambodia, Bancroft, Wildas, and Ishan was maintained. Ishan yielded very heavily and was comparatively free from disease. The habit of the plant was excellent but the lint was rather short and very harsh. None of the other varieties showed any promise.

West Indian Cottons.

A number of crosses made by Dr. Harland were received from the Empire Cotton Growing Corporation for trial. Considerable variation existed but several promising types were selected for further trial. Examination of the results of these has not yet been completed.

Increase Plots.

(*a*) *Small Bulk.*—Two plots of S.G. 23/8 were grown to provide a supply of seed for next year's main increase plot. One of the plots was used for detailed individual plant records. A great deal of data has been obtained and will be analysed as the opportunity occurs.

The yield from the second plot was at the rate of 706 lbs. per acre.

(*b*) *Medium Bulk.*—An acre plot was planted with B.P. 38/32, a U. 4 derivative which had yielded very well in the previous season's Pedigree Lines. The plot was divided into two, one half being sprayed with a tobacco soap spray and the other with water to ascertain if there was any effect on Lygus.

No effect on Lygus incidence was observed and the final yields of the two portions of the plot were practically identical. The plot yielded at the rate of 619 lbs. per acre.

Variety Trial (Bukalasa).

The following eight "varieties" were grown in an 8 ft. by 8 ft. Latin square:—

Local (Bukalasa).
Local (Nakisunga).
S.G. 23/8 (low shedder and good spinning qualities).
S.G. 29.
B. 31 (bulked—resistant to Blackarm).
B.P. 28/32 (B. 42 group, early maturing).
B.P. 38/32 (a U. 4/4/2 derivative).

The object of including Nakisunga Local was to ascertain whether there was any noticeable difference between "Locals" from different areas. The only difference observed was that the Nakisunga Local was far more variable as regards plant type than Bukalasa Local.

Planting took place in July and no varietal differences in germination were observed. Weekly counts of Angular Leaf Spot, Blackarm, Lygus, and Helopeltis infection were made throughout the season. B. 31 retained its marked resistance to Angular Leaf Spot and Blackarm while the next in order of resistance was B.P. 38/32. The two Locals were comparatively slightly attacked while the other varieties were more susceptible, although the effect of the disease was not severe and was not correlated in any way with the final yields.

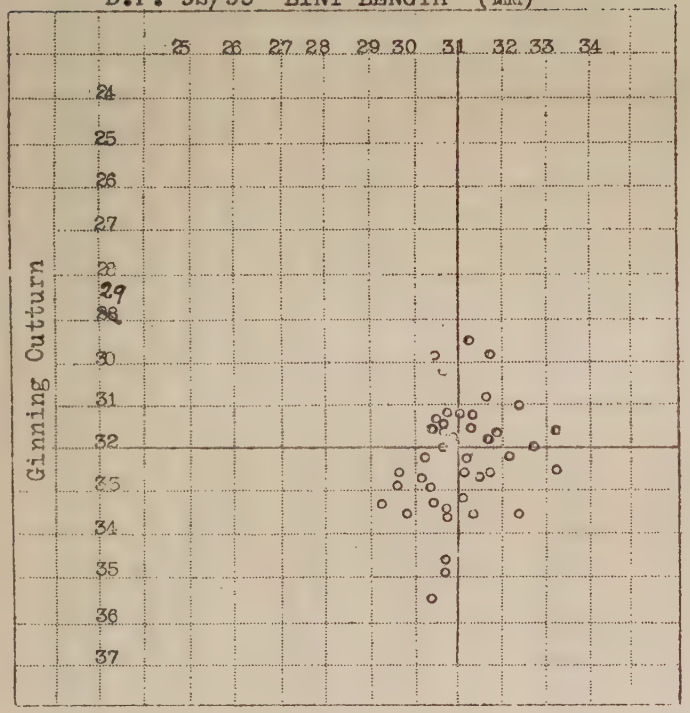
The following table gives a summary of the observations made on 8th November:—

TABLE IV.

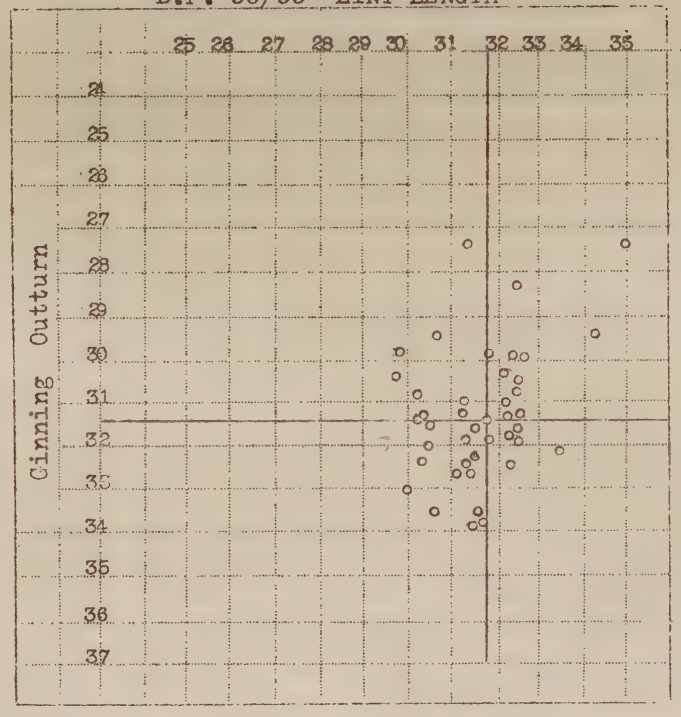
Variety.	% plants infected Angular Leaf Spot.	% plants infected Blackarm.
B. 31	35	8·2
Local (Nakisunga) ...	84	34·4
B.P. 38/32 ...	84	38·6
Local (Bukalasa) ...	80	36·4
B. 16 ...	92	42·8
S.G. 29 ...	96	49·4
S.G. 23/8 ...	93	54·2
B.P. 28/32 ...	95	63·6

PURITY TARGETS.

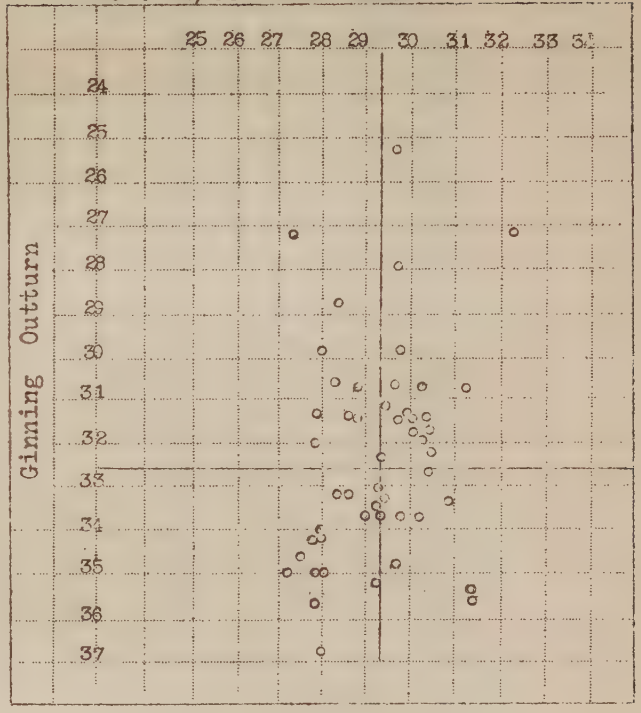
B.P. 52/33 LINT LENGTH (MM)



LINT LENGTH & GINNING OUTTURN.
B.P. 50/33 LINT LENGTH



B.P. 58/33 LINT LENGTH



Diagrams reproduced by the British East African Meteorological Service.

The Lygus and Helopeltis counts did not give much information except that there was an indication that B.P. 38/32 and S.G. 23/8 had slightly less severe Lygus damage than the other varieties.

With regard to plant habit, B.P. 38/32 was outstandingly better than the others. S.G. 29 and B 16 were particularly bad, the plants being badly "lodged" by the beginning of the picking season.

Picking Curves were very similar except for that of B.P. 28/32 which is a distinctly early maturing type and of S.G. 23/8 which is rather late in maturing. The Curves were single peaked owing to the abnomal dry weather.

The grade was excellent and the percentage of stained cotton very low. The staple was somewhat shorter than last year, Local and S.G. 23/8 being approximately 1 mm. less.

The following table is a summary of the results:—

TABLE V.

Variety.	Mean weight Seed Cotton per plot. *lbs.*	Percentage Stained Cotton.	Ginning Outturn.	Mean wt. Lint per plot. *lbs.*	Yield per acre Seed Cotton. *lbs.*	Lint Length. *mm.*	Lint Index.
S.G. 23/8 ...	45·0	7·8	33·8	15·1	1,801	28·9	5·6
Local (Bukalasa)...	44·1	8·7	29·7	13·1	1,764	28·6	4·7
Local (Nakisunga)	43·6	8·5	29·0	12·6	1,743	...	...
B.P. 28/32 ...	34·5	13·5	30·8	10·5	1,379	30·2	5·2
S.G. 29 ...	34·9	11·8	28·4	10·0	1,395	29·6	6·0
B. 16 ...	35·2	10·3	28·6	9·8	1,409	...	...
B. 31 ...	33·7	8·8	27·8	9·3	1,349	30·3	4·9
B.P. 38/32 ...	28·9	19·3	32·8	9·2	1,131	...	...
Mean ...	37·3	11·1	30·1	11·2	1,495	...	...
S.E. Difference ...	1·58	0·81	...	0·96	63·2	...	...
Significant Difference ...	3·16	1·62	...	1·92	126·4	...	...

Discussion of Results.

(*a*) *Seed Cotton.*—The results are significant when P=0·01 and show S.G. 23/8 and the two Locals to give similar yields and significantly higher yields than any of the other varieties.

This result is similar to that obtained last season. There are no differences between the other varieties except that all are significantly better yielders than B.P. 38/32. The high average yield of this trial is worthy of note.

(*b*) *Percentage of Stained Seed Cotton.*—The results follow closely those of last year and are highly significant. All varieties have less stained seed cotton than B.P. 38/32. There is no difference between S.G. 23/8, the Locals, and B. 31, and these four are significantly better than the other varieties in this respect.

B. 16 has significantly less than S.G. 29 and B.P. 28/32 while S.G. 29 has less than B.P. 28/32.

The percentage of stained seed cotton is much lower than last year, the average being 11·1 as against 17·1. The very high proportion in B.P. 38/32 is noteworthy. The U. 4 types appear to have a definitely high percentage under our conditions.

(*c*) *Ginning Outturns.*—These were done on bulk samples with a 12-inch gin. Both S.G. 23/8 and B.P. 38/32 have very satisfactory Ginning Percentages while B. 31 is disappointingly low.

(*d*) *Lint Yields.*—These results are significant when P=0·01.

S.G. 23/8 gives a significantly higher yield of lint than any other variety.

The two Locals come next and give higher yields than the remaining varieties between which there are no differences.

(*e*) *Summary.*—The general results are satisfactory. S.G. 23/8, which is still far and away the best spinning cotton, has held its own with Local and actually gave a higher yield of lint.

B. 31 was disappointing except that its resistance to Blackarm was definitely confirmed, and further selection may produce a higher yielding type. B.P. 28/32 was interesting on account of its early maturing character. B.P. 38/32 was definitely bad—it exhibited characters typical of U. 4 under these conditions—excellent habit, very heavy flowering, high rate of boll shedding, much shrivelling of bolls, high percentage stained cotton, high Ginning Outturn and harsh lint. Neither B. 16 or S.G. 29 are worth further trials under Buganda conditions.

Outside Variety Trials.

Variety trials to compare S.G. 23/8 with Local were conducted at the following centres:—

Mengo ... Kalagala.
Makurubita.
Nakisunga.
Nakifuma.

Entebbe ... Kabasanda.
Nkozi.

The following table summarises the results:—

TABLE VI.—YIELDS IN LBS. PER 1/40TH-ACRE PLOT.

Centre.	Local.		S.G. 23/8.		Mean yield per acre.
	Seed cotton.	Lint.	Seed cotton.	Lint.	lbs.
Kalagala	28·9	8·0	22·5	6·8	1,028
Makurubita	28·6	9·6	24·4	8·4	1,060
Nakisunga	19·5	6·4	21·4	7·1	818
Nakifuma	26·9	8·3	26·4	8·8	1,066
Nkozi	34·8	12·0	35·1	12·1	1,398
Bukalasa	44·1	13·1	45·0	15·1	1,782
MEAN ...	30·5	9·6	29·1	9·7	1,192

The indications are that there is no difference in yield between S.G. 23/8 and Local but S.G. 23/8 appears to have a better Ginning Outturn by 1—2 per cent. and is a much superior cotton from the spinning point of view. Comparing the results with those of last year the relationship between the two varieties remains the same but there is a distinct reduction in average yield at all centres except Bukalasa where an increase of 650 lbs. is recorded. S.G. 23/8 can be said to be a definite advance on Local from a spinning point of view but as the yields are practically identical there would be no point in replacing Local with S.G. 23/8 unless a high enough premium was paid for the lint to benefit the growers.

Spinning Tests and Brokers' Reports (1932-33 Crop).

The following reports were received from Messrs Wolstenholme & Holland on a series of samples sent for spinning tests:—

TABLE VII.

Variety.	Length of staple.	Strength.	Valuation (based on middling American 5·37).
S.G. 23/8 (Bukalasa) ...	Good $1\frac{1}{8}''$	Medium ...	6·07
Local (Bukalasa) ...	Full $1\frac{1}{8}''$ irregular	Strong ...	6·37
S.G. 23/8 (Nakifuma) ...	Full $1\frac{1}{8}''$ irregular mixed with short ...	Medium ...	6·17
Local (Nakifuma) ...	$1\frac{3}{16}''$	Strong ...	6·37
S.G. 23/8 (Mpigi) ..	$1\frac{3}{16}''$	Medium ...	6·27
Local (Mpigi) ...	$1\frac{3}{16}''$	Strong ...	6·47

These are interesting as they again show the inability of the Broker to identify a good spinning cotton. In these and all previous spinning tests S.G. 23/8 has proved distinctly superior to Local, especially in yarn strength. Here in each case Ball's Paradox is borne out—S.G. 23/8 with its low hair weight per centimetre and the strong yarn is only classed by the broker as "medium strength" and *in each case loses points for this.*

The following table summarises the Spinning Test results:—

TABLE VIII.

Sample.	Actual Count.	Lea Strength lbs.	Count × Strength.	Count × Work of Rupture.	Highest Standard Count.
50's					
Bukalasa.—					
S.G. 23/8	49·3	50·0	2465	2875	70—75
Local	48·7	38·8	1890	2401	40—44
Nakifuma.—					
S.G. 23/8	49·0	50·1	2455	2901	73—77
Local	50·0	39·8	1990	2345	48—52
Mpigi.—					
S.G. 23/8	50·5	43·2	2182	2608	58—62
Local	49·0	40·1	1965	2489	44—48
64's					
Bukalasa.—					
S.G. 23/8	63·4	34·4	2181	2620	...
Local	63·2	25·9	1637	2038	...
Mpigi.—					
S.G. 23/8	63·3	27·3	1865	2116	...
Local	63·9	26·5	1693	2356	...
80's					
Nakifuma.—					...
S.G. 23/8	79·1	24·1	1906	2195	...
Local	77·8	19·7	1533	1989	
Mpigi.—					
S.G. 23/8	81·7	20·3	1659	2047	...
Local	73·9	21·0	1552	2010	...

It will be seen that S.G. 23/8 is definitely superior to Local except at Mpigi where there is very little difference. The report states, *inter alia*: ". . . . . in all three localities S.G. 23/8 has a lower hair weight per centimetre than Local. Samples of S.G. 23/8 and Local have higher hair weights per centimetre than the corresponding samples tested last season." . . . "In strength S.G. 23/8 is by far the best in all three localities but its superiority is less marked at Mpigi than at Nakifuma and Bukalasa."

A further series of samples were tested at the Technological Laboratory of the Indian Central Cotton Committee. The results of these are summarised below:—

TABLE IX.

Variety.	Points on (Basis 200 Rs.)	Mean Fibre Length ins.	Fibre weight per inch (millionth of an ounce.)	Highest standard warp counts.	Strength × Count.		
					30's.	40's.	50's.
Bukalasa:—							
S.G. 23/8 ...	135	1·06	0·107	65	2388	2141	2026
Local ...	120	1·01	0·141	46	1965	1720	1593
Nkozi:—							
S.G. 23/8 ...	125	1·05	0·113	55	2227	1982	1816
Local ...	115	1·04	0·133	45	1877	1692	1565

"Of the eight cottons, S.G. 23/8 grown at Bukalasa has given the best spinning performance while the same cotton grown at Nkozi is much inferior in its performance . . . the performance of the two Local cottons is markedly inferior to that of S.G. 23/8."

This season's results confirm those of previous years in demonstrating the definite superiority of S.G. 23/8 over Local Buganda from a spinning point of view.

Thanks are due to the Indian Central Cotton Committee, the Empire Cotton Growing Corporation and the British Cotton Industry Research Association, and also to Messrs. Wolstenholme and Holland, for so kindly arranging for and carrying out the examination and tests of these samples.

Tobacco.

A start was made with tobacco at Bukalasa and a number of imported varieties were grown under trial. Planting was done in both Spring and Autumn rains—the Spring planting was severely checked by drought and practically ruined by hail but the Autumn planting was quite successful and some really good air cured tobacco was prepared, the best varieties being Greenwood, Sweet Burley, Judy's Pride, White Burley and Judy's White Burley. Fire Curing was not so successful but some varieties, *e.g.*, Cash 29, Improved Clarkwille and Western S, produced some quite good leaf.

Selfed seed was obtained from all varieties and selection will commence in 1934.

Simsim.

A number of varieties from Lango were tried out. These were found to be splitting freely for seed and other characters and selection was done within the varieties, special attention being paid to habit, seed colour, yield, earliness, and resistance to disease. Several local selections were made in the villages and these will be included in next year's breeding plot.

Groundnuts.

The main work on groundnuts is still done by this section at Serere but a few single plant selections were made locally and will be tested in 1934.

Ginger.

A trial plot of "local" ginger was planted but suffered badly from drought and as a result took a very long period to mature. The whole crop is being utilised for an increase plot in 1934 from which it is hoped will be obtained a commercial sample for reports.

Tea.

In October a visit was made to the Kenya Tea Estates at Kericho and through the courtesy of the African Highlands Produce Co., and of the Kenya Tea Co., a great deal of useful information on tea was obtained. A separate report on this visit has already been submitted.

Coffee.

Observations on a number of selections made by Mr. Liebenberg, and planted out at Bukalasa, have been carried on, several of these are quite promising as regards yield, habit and size of berry.

Other Crops.

Selection work on a small scale is being carried out with Pigeon Pea, *Dolichos Lablab* and Castor Oil.

Diseases and Insect Pests.

(*a*) Cotton.—As usual, *Angular Leaf Spot* and *Blackarm* were present but their incidence was not severe on account of the dry weather. Observations on resistance and susceptibility were continued. B. 31 continued to show resistance but did become heavily infected with what might be called a secondary Blackarm attack at the end of the season. The B. 37 group appeared susceptible but produced an excellent crop all the same; it is possible that this group, although not resistant to infection, may be resistant to the effects of the disease.

The only other serious disease was *Wilt* which has definitely spread at Bukalasa and in Buganda generally in the last two years. At least 100 infected plants occurred on the Plantation; these were uprooted and burnt as soon as they appeared to be suffering from the disease.

Several families of B. 31 appeared to be very susceptible to it. Work on resistance is being taken in hand at once.

Insect pests were very much less in evidence than in the previous season. *Lygus* did a certain amount of damage. *Helopeltis* was only observed on a May sown plot of S.G. 23/8 and although there was an adjacent plot of the same variety planted in July it was practically free from this pest. It is interesting to note that this plot was the only one on the whole plantation which was attacked by *Dysdercus* spp. Hand picking reduced the infection to a practical minimum. Actually, the attack did not occur until March when most of the crop had been harvested.

Boll-worms were present as usual. No Pink Boll-worm has been found as yet on or near the Plantation.

Jassids were expected in the dry weather but they were never present in vast numbers and the susceptible S.G. 23/8 showed no signs of damage.

Syagrus did a great deal of damage on old land. No plants were attacked on new or practically new plots.

(*b*) Tobacco.—The most serious disease was a leaf crinkle which reduced many plants to the appearance of Brussels sprouts. It was definitely at its worst on poor patches of soil.

Various leaf spots occurred but none in very serious proportions.

Pole burn occurred in the barn on account of the tobacco being allowed to hang for too long after curing was completed.

Insect damage was mainly confined to crickets and kindred insects.

(*c*) Groundnuts.—As usual, Rosette disease was practically non-existent in the Spring sown crop. The Autumn sown crops were infected but not to anything like the extent of last season.

Cotton Increase in Buganda.

The question of a seed farm and its attendant stages for Buganda is still engaging attention and the possibilities of the Entebbe Peninsular as a seed farm stage are being fully explored. A Main Bulk Area is now available at Bukalasa where the segregated ¼-acre, 1-acre and 18-acre increase plots are now arranged for. S.G. 23/8 will be put into the main bulk stage next season.

G. W. NYE,
Senior Botanist.

PART III.—BOTANICAL WORK AT SERERE.

Meteorological Conditions, 1933-34.

Weather conditions, both at Serere and in the district, were undoubtedly good over the season as a whole. The result was an excellent cotton crop everywhere this side of the Nile.

The month of May was ideal for cotton planting and early-planted cotton did well. June and July, however, were decidedly dry in some districts, and at Serere the rainfall was too irregular to be of much use. Consequently late cotton—unfortunately all too prevalent in the district—became very late cotton indeed, much of it being planted in September. The situation was saved by rain in mid-December, which gave a stimulus to the late crop, although it stained some of the early cotton. Finally an almost rainless buying season produced a crop beyond expectation in quantity, and in quality the best for many years.

SERERE, 1933-34 SEASON. WEATHER CONDITIONS.

Month.	Rainfall.	Sunshine.	Remarks.
1933.			
April ...	Exactly average ...	Much above average ...	Irregular distribution of rains. Groundnut planting not very successful.
May ...	Nearly 1½ inches above average.	Slightly above average	Regular distribution of rain. Good for planting cotton and groundnuts.
June ...	Slightly above average ...	About average ...	Very irregular distribution of rain. Only the last ten days favourable for cotton planting.
July ...	Slightly below average ...	Very much above average.	Distribution of rain irregular. Cotton planting only possible in the middle of the month. Last part dry.
August ...	Over 2¼ inches below average.	Above average. Typical July sunshine.	Very dry in the early part of the month. On the whole not favourable for cotton planting.
September	1 inch above average ...	Much below average ...	Rain very well distributed up to 24th. Ideal for planting, hence the high proportion of very late cotton in the Segregated Areas.
October ...	Nearly 2 inches below average.	About average ...	Early cotton flowered freely, but late cotton suffered from drought. Dry weather checked the spread of Angular Leaf Spot but Jassids came in large numbers.
November	Nearly 2 inches below average (a little hail but did no damage).	Below average, perhaps on account of smoke.	Long dry spells were a check on Blackarm but Jassids damaged Nariama family of cottons very severely at Serere.
December	Nearly 1 inch above average.	Below average—much smoke.	Rain up to 18th and then dry. Great benefit to late cotton, but a lot of rain-stained cotton from early plantings.
1934.			
January ...	Virtually nil ...	Much above average ...	Early plantings reached their bolling peak early in the month and had almost finished at the end.
February...	Virtually nil ...	Above average ...	Early cotton produced a top crop; all the main crop ripened off early in the month.
March ...	Virtually nil ...	About average ...	Flow of cotton to buying posts prolonged beyond expectation. Planting of food crops much delayed.

Cotton.

DISEASES AND PESTS.

Bacterium malvacearum.—Angular Leaf Spot and Blackarm counts are recorded in the sections dealing with the Cotton Breeding Plot and the Variety Trials, and the disease is one of the main items of the Mycologist's Annual Report. The leaf-spot stage spread rapidly in May and June and again in September, but, as a dry spell followed on each occasion, Blackarm lesions did not become a serious disease for the season.

Jassids.—The dry spells of October-November and January-February gave a stimulus to Jassid activity. Jassids were present in sufficient numbers to make susceptible varieties apparent in the breeding plot, thus greatly assisting the task of selection. They undoubtedly influenced the crop in certain areas, but the damage was not serious.

Helopeltis bergrothi.—Numbers of these insects occurred at the western end of Block A and the Breeding Plot on account of the crop of sweet potatoes across the road. Corky scabs were noted on green bolls in November, and many plants were stunted. The pest did not assume serious proportions in any of the districts this year.

Lygus vosseleri.—The attack of this insect was worse than usual at Serere, but the damage was not noticeable after the leaf-shedding that occurred during the dry spell in October and November.

Dysdercus spp.—Though not a serious pest, Cotton Stainers were comparatively plentiful at Serere. Migration to the Breeding Plot was observed on December 11th.

Platyedra gossypiella.—The Pink Bollworm was recorded east of the Nile at Jaber and as far as Ngetta Farm. It may have been one of the many pests that damaged the Cotton Variety Trial at the latter centre. It was not recorded in the Eastern Province.

Earias spp. and *Argyroploce* spp. were present as usual at Serere, but not in abnormal quantity.

A Fusarium wilt disease attacking the roots of cotton was observed for the first time. It only occurred on varieties the seed of which had been imported from Bukalasa, and it is probable that the disease came from that source. All the Bukalasa strains save one which was not affected were uprooted and burnt, and the plot has now been put down to a permanent rotation crop.

THE COTTON BREEDING PLOT.

PEDIGREE LINES.—41 strains were planted as follows :—

27 U. 4/4/2 derivatives numbered S.P. 39—65.
8 Nariama „ „ S.P. 66—73.
5 Acala „ „ S.P. 74—78.
1 U. 4 derivative numbered S.P. 79 (Southern Rhodesia).

The five Acala strains were all abandoned on account of susceptibility to Jassid and poor habit.

NEW SELECTIONS.—81 new selections were planted as follows :—

Nyasaland Upland group :—	
2 S.G. 29 derivatives numbered	S. 48—49
9 Nariama „ „	S. 50—58
9 re-selections derived from local selections made in previous years	S. 63—64 S. 78—84
16 local selections from the 1932-33 crop ...	S. 85—100
Cambodia group :—	
4 re-selections numbered	S. 59—62
Acala group :—	
13 re-selections numbered	S. 65—77
U. 4 group :—	
8 U. 4 derivatives numbered	S.U. 33—40
19 U. 4 (Southern Rhodesia) derivatives numbered ...	S.U. 41—59
1 U. 4/4/2 derivative numbered	S.U. 60

The one remaining Bukalasa strain, B.P. 49, was also planted in this series, but it suffered very badly from Blackarm and Helopeltis. A large proportion of the above series were abandoned on account of Blackarm, Jassid or bad habit, and only 42 were retained for analysis.

NEW INTRODUCTIONS.—34 hybrid strains received from Dr. Harland, Trinidad, were planted. The first series of nine, numbered by us X. 12—20 did extremely well ; and three of them, X. 13, 14 and 17, had such good lint that their characters are included with the Pedigree Lines in the tables that follow. The second series, of which twenty-five were tried out of a much larger number received, proved disappointing. After abandoning strains susceptible to Blackarm and Jassid only 14 remained for analysis.

GENERAL.—The plot was planted on July 5th according to custom. It had to be hand-watered until the 9th and the original stand was very poor. The final stand obtained was satisfactory. Slight hail in November did no appreciable damage and it was possible to make notes on habit all through the plot. In the absence of habit notes from the previous year these records were very enlightening.

Flowering and the first pick are the earliest on record. Flowering was very prolific, being about 40% more than last year. Rain in mid-December caused two picks to be badly rain-stained. Many of the early strains produced their peak pick in little over five months,

and their main crop was finished in less than seven. S.P. 39 is the earliest strain and in addition it is a very neat, small type of plant.

Diseases and Pests.—The Mycologist examined every plant in the Breeding Plot. As last year, he awarded marks ranging from 0 to 6 for the incidence of Angular Leaf Spot, but on a more exacting scale. He also counted at a later date the number of Blackarm lesions on each plant, instead of assigning marks as last year.

The Pedigree Lines were interplanted with rows of S.G. 29 as a Blackarm index. In all cases the new strains had considerably less Blackarm than the rows of S.G. 29. In a few instances seed from the most susceptible plant in the same strain was planted in place of the S.G. 29 control. The object of this was to see whether selections breed true for resistance and susceptibility to Blackarm. It was found that they do, as in every case the Pedigree Line had fewer Blackarm lesions than the more susceptible relative.

The Nariama family is still resistant to Blackarm, some more that others, but the lint length tends to be short, the yields are not satisfactory, and the strain appears to be very susceptible to Jassid.

The U. 4/4/2 family is still very resistant to Blackarm and Jassid.

The Acala strains were all abandoned on account of susceptibility to Jassid and poor habit.

Lint.—There was a very high proportion of immature cotton in all strains, and a most disconcerting variation in staple even on individual plants. It was not uncommon for one plant to have a range of 10 mm. in lint length between different pulls, and something of the order of 7 mm. variation was the rule throughout the Breeding Plot. Cotton from a neighbouring ginnery was found to contain 38% of short hairs (under one inch); the corresponding figure last year was 31%.

The tables below show that the lint lengths obtained from the Pedigree Lines are most disappointing. Allowance must, however, be made for the fact that all cotton in the immediate district was short this season. Trials with the Ball's Sorter showed that it was anything up to 1/16th inch (1·5 mm.) shorter than last year. The lint length of S.P. 72, which is a relative of the local cotton, may perhaps be taken as an index; it is 30·1 mm. as against the 31·6 mm. of its parent S.P. 36 last year.

July 5th, the customary sowing date for the Breeding Plot at Serere, proved to be an unfortunate one this year. In consequence there were a large number of stunted plants in the Breeding Plot; these gave an insignificant yield combined in almost every case with very poor lint. For this reason an extra column has been included in the table which follows showing the average lint length of a few plants from each strain selected for yield irrespective of every other desideratum. The number of plants included in each sample is noted in brackets. The lint length is raised by this treatment in every case except that of S.P. 40, where it is actually depressed, and it is interesting to note that S.P. 40 was, in a broker's opinion, shorter than S.P. 48. The average from all plants in the line, therefore, appears to be misleading.

The following tables summarise the characters of the leading strains:—

(*a*) Biological Characters.

	Habit.	Jassid.	Blackarm lesions per plant.	Flowers per plant.	Shedding %	Date of:— 1st flower.	Peak pick.
S.P. 39 ...	Excellent; small ...	Nil	0·05	55	61	Sept. 4th ...	Dec. 19th.
S.P. 40 ...	Good	Nil	0·14	58	66	Sept. 4th ...	Dec. 27th.
S.P. 43 ...	Good; rather large ...	Nil	0·04	61	63	Sept. 7th ...	Dec. 27th.
S.P. 48 ...	Good	Nil	0·10	66	74	Sept. 6th ...	Dec. 27th.
S.P. 56 ...	Fair; large; not quite straight ...	X	0·04	50	63	Sept. 6th ...	Jan. 9th.
S.P. 57 ...	Fair; irregular ...	X	0·09	46	63	Sept. 6th ...	Jan. 16th.
S.P. 72 ...	Poor; straggly ...	XXX	0·10	44	61	Sept. 8th ...	Jan. 9th.

(*b*) Boll Characters.

	Number of Bolls per Plant.	Number of Sound Locs per Plant.	Clean Locs per Boll.	Seed Cotton per Boll (grs.)	Seed Cotton per Plant (grs.)	Immaturity %
S.P. 39	21·4	34·5	1·6	2·9	61·2	11
S.P. 40	19·5	30·1	1·5	2·9	57·3	26
S.P. 43	22·3	29·5	1·3	2·7	61·2	28
S.P. 48	17·1	28·4	1·7	3·4	58·4	21
S.P. 56	18·3	24·9	1·4	2·7	48·7	38
S.P. 57	17·2	22·9	1·3	2·7	47·1	33
S.P. 72	17·1	28·1	1·6	3·0	51·9	29
X. 13	22·5	47·1	2·1	3·3	73·7	12
X. 14	23·7	52·2	2·2	3·7	87·9	25
X. 17	13·9	24·0	1·7	3·4	47·5	19

(c) Lint and Seed Characters.

	Origin.	Ginning Out-turn. %	Seed Weight 100 seeds (grs.)	Lint Length (mm.)	Lint Length of high-yielding plants.	Area of Ellipse on Purity Target.
	U. 4/4/2.—					
S.P. 39...	S.P. 13	37·2	8·0	30·4	30·9 (5)	33
	S.P. 20					
S.P. 40...	S.P. 13	37·0	7·9	30·2	30·0 (9)	33
	S.P. 20					
S.P. 43...	S.P. 13	36·8	7·8	30·5	31·3 (10)	...
	S.P. 20					
S.P. 48...	S.P. 13	36·0	8·7	29·5	29·8 (7)	33
	S.P. 22					
S.P. 56...	S.P. 14	34·5	7·6	29·6	30·2 (7)	69
	S.P. 25					
S.P. 57...	S.P. 14	34·6	8·3	30·4	31·1 (7)	...
	S.P. 26					
	Nariama.—					
S.P. 72...	S.P. 36	32·2	8·4	30·1	30·8 (8)	38
X. 13...	Cambodia × U. 4 × Jamaica Xerophytic	31·2	9·1	32·2	...	...
X. 14...	2 (Cambodia) × Jamaica Xerophytic	31·4	9·9	31·5	...	...
X. 17...	U. 4 × Mead	30·5	9·8	33·5	...	...

N.B.—"Area of Ellipse on Purity Target" refers to Ginning Out-turn Lint Length purity target diagrams. It is the area of an ellipse defining the limit of error due to chance (P = 0·05). The figures can only be compared the one with the other as the units have no particular significance. A low figure indicates a high degree of purity. The area of the ellipse for S.P. 1, the great-grandparent of the U. 4/4/2 family, was 86.

COTTON VARIETY TRIAL, SERERE.

This was laid out in the form of a 7 by 7 Latin square on Block A of the experiment farm. Standard plots (27 ft. by 27 ft.) and standard spacing (3 ft. by 1 ft.) were adopted. The varieties were :—

S.G. 29 (now grown almost throughout the Eastern Province).
S.P. 35 (Nariama, *i.e.*, S.G. 29 derivative).
S.P. 1 (U. 4/4/2 derivative, 1st generation).
S.P. 13 („ „ 2nd „).
S.P. 20 („ „ 3rd „).
S.P. 21 („ „ „ „).
S.P. 23 („ „ „ „).

The experiment was sown on July 10th.

Blackarm.—Three counts of the number of plants showing Angular Leaf Spot infection were made: on August 15th, September 4th and 5th, and September 27th. The percentages of infected plants at the last count are given below, and also the ratios of these percentages to the percentages of plants showing Blackarm lesions on November 15th.

	A.L.S. %		B.A./A.L.S.
S.P. 13	60·0		0·40
S.P. 21	76·4	Differences	0·38
S.P. 1	77·0	of	0·49
S.P. 20	84·6	13·7% are	0·36
S.P. 23	93·3	significant.	0·29
S.P. 35	93·9		0·90
S.G. 29	95·7		0·91

The interest of this Table lies in the last column. In the varieties S.G. 29 and S.P. 35 infection with Angular Leaf Spot leads to Blackarm lesions in almost every case. In the U. 4/4/2

family Angular Leaf Spot infection may be fairly severe, but more than half the plants so affected throw it off and never develop Blackarm lesions.

Counts of the number of plants showing Blackarm lesions were made on October 13th and November 15th ; both gave similar results and the percentages of infected plants at the second count are given below :—

PERCENTAGE OF PLANTS WITH BLACKARM LESIONS.

S.P. 13	24·0	Differences of 7·5% are significant.
S.P. 23	26·8	
S.P. 21	28·9	
S.P. 20	30·2	
S.P. 1	37·6	
S.P. 35	84·2	
S.G. 29	86·7	

The results of this examination are very striking, showing that the U. 4/4/2 derivatives have a resistance to Blackarm which places them in an altogether different class from the Local cotton. Moreover, selection within the U 4/4/2 family has led to a further significant improvement.

JASSID.—It was obvious to the most casual observer that S.G. 29 and S.P. 35 were susceptible varieties, but as no counts of nymphs were made, this statement cannot be substantiated by figures. In mitigation of this, however, it must be stated that S.P. 35 was the worst of the Nariama derivatives, particularly as regards Jassid, but unhappily was the only one of which seed was available for a Variety Trial. Of the U. 4/4/2 derivatives S.P. 23 appeared to be slightly less resistant than the rest.

HABIT.—The Local cotton and its Nariama derivative have a very poor habit, and between them and the U. 4/4/2 derivatives there is no comparison. S.P. 35 is slightly more upright than S.G. 29 but the tendency of both to bend right down to the ground late in the season appears to be even more marked on Government Plantations than it is in the districts, probably on account of exposure. Of the U. 4/4/2 derivatives, S.P. 13 is quite the best for type of habit. S.P. 1 naturally is less regular for type. The third generation tend to be too tall, particularly S.P. 23.

YIELD.—Yield is summarised in the following table. The yield of clean cotton from each variety was ginned separately at Agu ginnery through ordinary 40-inch Platt's Roller Gins without special adjustment. All yields are expressed as pounds per acre :—

	Days.	Total Yield Seed Cotton.	Clean Cotton.	Ginning %	Clean Lint.	Lint as % of S.G. 29.
S.P. 13	167	687·1	521·4	37·6	196·0	160
S.P. 1	171	673·2	523·4	36·8	192·4	157
S.P. 21	168	673·1	528·6	37·8	199·5	163
S.P. 20	169	648·2	495·1	37·6	185·8	152
S.P. 23	178	585·6	457·8	36·8	168·4	137
S.G. 29	175	492·3	393·0	31·2	122·5	100
S.P. 35	179	401·2	323·8	30·1	97·5	80
LEAST SIGNIFICANT DIFFERENCE ...		106·6	97·7	..	...	...
MEAN		593·9	463·0	...	166·0	...

NOTE.—The figures given under the heading " Days " in the above table show the number of days taken by each variety to produce 1 lb of cotton, reckoned from the date of sowing, and summed over the whole season.

DISTRICT COTTON VARIETY TRIALS.

As in the previous season, a 4 by 4 Latin square was planted at each of ten centres. A separate draw was made at each centre. The following varieties were used :—

N. 17 (Old standard variety in the Eastern Province now being replaced).
S.G. 29 (New standard variety in the Eastern Province).
S.P. 1 (U. 4/4/2 derivative—1st generation).
S.P. 13 (U. 4/4/2 derivative—2nd generation).

Blackarm.—The Mycologist made counts at Ngetta and Wanyange of the number of plants seriously infected with Blackarm lesions. These results are very significant :—

	Ngetta.	Wanyange.
	Per cent.	Per cent.
S.P. 13	6	17
S.P. 1	8	18
N. 17	31	35
S.G. 29	44	51
Least Significant Difference ...	4	6

In addition, the proportion of stained cotton, a factor which to some extent follows the incidence of Blackarm disease, was analysed at each centre. Significance was obtained at only one centre, Mulanda, where Blackarm was more serious than at other centres.

	% Stained Cotton.	
S.P. 13 ...	19·6	Least Significant Difference is 0·5%.
S.P. 1 ...	25·3	
N. 17 ...	28·1	
S.G. 29 ...	29·9	

Habit.—Notes were made plot by plot at each centre. The characteristics of S.G. 29, S.P. 1 and S.P. 13 were found in general to be the same as at Serere. N. 17 was found to be superior in habit and Jassid resistance to S.G. 29.

Yield.—The following are yields of unsorted cotton expressed as lbs. per acre :—

	N. 17.	S.G. 29	S.P. 1.	S.P. 13.	Least Significant Difference.
Lango.—					
Ngetta	452	482	578	605	—
Aduku	386	283	359	344	—
Kaberamaido	614	659	804	1011	166
Teso.—					
Nyero	375	310	513	520	—
Bugwere.—					
Kibale	752	652	822	1064	166
Kachumbala	379	399	556	665	200
Budama.—					
Mulanda	578	653	825	612	—
Busoga.—					
Wanyange	216	207	331	506	161
Bugaya	248	245	296	380	—
Vukula	315	379	390	502	—
Mean	432	427	547	621	42

The seed cotton was picked over and the clean cotton was ginned by plots (not varieties) at commercial ginneries through ordinary 40-inch Platt's Roller Gins which were not specially adjusted. One gin only was used for the cotton from each centre ; Ngetta cotton was ginned at Ngetta ; the

rest were ginned at Agu, cotton from Nyero being passed over a hide roller. The following table summarises the yields of clean lint expressed as lbs. per acre, and the ginning percentages :—

	N. 17	S.G. 29	S.P. 1	S.P. 13	Least Significant Difference.
Ngetta	82	82	94	111	—
Aduku	101	76	107	106	—
Kaberamaido	155	168	214	288	49
Nyero	99	86	156	169	18
Kibale	187	159	224	294	31
Kachumbala	92	98	153	210	68
Mulanda	136	148	221	183	—
Wanyange	15	23	31	73	26
Bugaya	60	60	78	103	—
Vukula	70	85	97	127	33
MEAN	100	99	137	166	12
GINNING PERCENTAGE	30·9	31·9	35·0	36·9	0·4

SUMMARY.—It is obvious that except for lint characters, which are dealt with below, the U. 4/4/2 family has everything to commend it. The susceptibility of S.G. 29 to Blackarm, revealed in the trials this year as being significantly greater than that of N. 17, is a decided disadvantage. The effect on the crop in a bad Blackarm season might be serious.

SPINNING TESTS (1932-33 CROP).

Samples of N. 17, S.G. 29, S.P. 1 and S.P. 13 from various centres were submitted to the British Cotton Industry Research Association and the Indian Central Cotton Committee. The summary made by the former institution may be quoted in full :—

> "S.G. 29 is slightly superior to N. 17 at Serere, about equal to N. 17 at Ngetta and Mulanda, and inferior to N. 17 at Wanyange.
>
> Ngetta and Serere gave the strongest yarns, Mulanda the best looking yarns, and Wanyange the poorest yarns—taking into account both strength and appearance. S.P. 1 is better at Ngetta than at Serere ; there is little to choose between S.P. 1 and S.P. 13 at Serere, except that S.P. 13 gave yarns slightly inferior in appearance than those spun from S.P. 1 (Serere)."

The report from the latter institution is in all essentials similar. Neither institution compares the U. 4/4/2 family with the Local cottons directly, but it is noted from the spinning data that the former is shorter, does not spin at the same high counts, and entails a 14% loss of premium.

In view of the fact that the lint character and spinning quality of S.P. 1 and S.P. 13 are considerably behind the standards set by the present Uganda cottons, whilst in all other characters these strains show a marked advance, it was thought advisable to forecast the possibilities of the family by obtaining the opinion of local lint brokers upon later generations bred at Serere. The following table includes their opinions on a number of strains in the direct line of descent :—

	Lint Yield Serere Variety Trial.	Brokers' Opinion.
S.P. 1 (1st generation) ...	192·4	Short ; weak ; lies closer and less springy than S.G. 29.
S.P. 13 (2nd generation) ...	196·0	Same character as S.P. 1. Same length : slightly stronger, more irregular.
S.P. 20 (3rd generation) ...	185·8	Better colour than S.P. 1 and 13 ; slightly more silky, but weaker. More desirable than S.P. 1 and 13.
S.P. 39 (4th generation) ...	...	Possibly shorter than S.P. 23, but stronger and silkier. (S.P. 23 is a related variety described as :— Definitely longer and more silky ; more attractive than S.P. 20. Not much behind S.G. 29, though slightly shorter and weaker.)

These opinions may be taken as an indication that there is a distinct possibility of further improvement of the lint characters of this family with continued selection.

COTTON INCREASE PLOTS AT SERERE

	Acreage.	Yield of seed cotton (lbs./acre).
S.P. 20	0·25	581
S.P. 21	0·25	583
S.P. 23	0·25	406
S.P. 36 (Nariama) ...	0·25	259
S.G. 29	3·00	543
S.G. 29	10·00	275

LYGUS SPRAYING EXPERIMENT.

This season the experiment consisted of three treatments replicated in five blocks; no significant result was obtained. The yields, expressed as lbs. per acre are as follows :—

(*a*) Sprayed with Tobacco Extract 513
(*b*) Sprayed with water only 455
(*c*) Control, unsprayed 448

The observation that plants sprayed with tobacco extract show less leaf perforation and remain greener through the season was repeated. The extra controls, sprayed with water only, did not show this effect.

COTTON SEED MULTIPLICATION—SEGREGATED AREAS.

The scheme described in last year's Report has continued to operate. The variety S.G. 29 was planted throughout.

(*a*) *Mulondo.*—Planting was much delayed by the illness of the local chief, and there was a high proportion of late sown cotton. The monthly plantings were as follows :—

May	*June.*	*July.*	*August.*	*Sept.*	*Total.*
Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
5·5 ...	51·5 ...	166·8 ...	110·3 ...	27·8 ...	361·9

The seed was S.G. 29 grown at Serere in the previous season.

An agricultural survey of the area was made in September to ascertain its working strength.

(*b*) *Labori-Kadunguru*—S.G. 29 seed grown in Mulondo in 1932-33 was supplied to this area.

(*c*) *Serere-Kasilo*—S.G. 29 seed grown in Labori-Kadunguru in 1932-33 was supplied.

Seed from the 1932-33 crop was sent to Bugwere District and to North and Central Bugishu. Seed from the 1933-34 crop has been sent to Central and South Bugishu and to Budama Districts. Both issues replace the variety N. 17. The second distribution to Central Bugishu was occasioned by changes in the plans for the zoning system introduced in the 1934 buying season.

The yield statistics for the three segregated areas are as follows :—

	Acres.	Buyings.	Yield per acre.	% Stained Cotton.
		lbs.	*lbs.*	
Mulondo	362	133,031	367	9·7
Labori—Kadunguru	4,821	1,355,385	281	12·6
Serere—Kasilo	28,785	7,807,514	271	13·1
TOTAL	33,968	9,295,930	274	13·0

The average prices realised by natives were :—

"A" quality—Shs. 8/97 per 100 lbs.
"B" „ —Shs. 6/54 „ „ „
"C" „ —Shs. 4/00 „ „ „

Mulondo Survey.—This showed that alien tribes from across the lake who make up 34% of the population are not such efficient cotton growers as the native Teso. The average family of one taxpayer, two other workers and one non-worker, plant an average of 1·85 acres of cotton. The Teso taxpayer, on the other hand, plants an average of 2·40 acres of cotton.

Tobacco.

A start was made in 1933 in the work of selection of this crop at Serere. 29 varieties of tobacco were introduced from Nyasaland, South Africa, Canada, and the U.S.A. A further ten varieties were brought from Bunyoro. Work was confined to observation and mass selection.

Bulo (*Eleusine coracana*).

Preliminary selection work was carried out in 1933 by observations on this crop, and by selection of a large number of single plants from 13 local Teso varieties. Unfortunately the cropping scheme of the Serere Farm did not allow for such early planting as is customary in the district, and the crop suffered from drought. The selections were made mainly on the score of resistance to a very prevalent disease, thought to be "Rice blast." These are to be planted in lines this season.

Groundnuts.

Breeding Plot.—The groundnut selection work begun in 1932 was continued. 76 selections of the Spreading type and 78 of the Bunch type were sown on April 5th. The incidence of Rosette disease was high, and the crop a moderate one. Plans of the incidence of Rosette were made weekly, and only those plants remaining entirely free from Rosette at the close of the season were considered for selection. After shelling for planting in 1934, these were re-selected on the basis of the following criteria :—

	Spreading.	*Bunch.*
Shelling percentage	60 ...	60
Weight of kernels (in gms.)	30 ...	25

As a result, 35 selections of the Spreading type and 40 of the Bunch type are to be planted in lines in 1934. In addition, eight Spreading varieties and six Bunch varieties are to be sown in small increase plots.

Variety Trial.—A Variety Trial in the form of a 7 by 7 Latin square was planted on April 24th. The following is a summary of the results, yields being expressed as lbs. of kernels per acre :—

	% of Rosette.	Yield.	Shelling %.
African Bunch	1·9	930	72·5
Local Spreading	7·1	833	56·8
Bunch (Mass Selected 1929)	4·6	816	67·5
Virginia Bunch	3·1	792	65·6
Bunch (Mass Selected 1930)	7·0	694	65·0
Tanganyika Bunch	8·0	617	63·1
Spreading (Mass Selected 1930)	25·7	488	48·8
Least Significant Difference	11·6	142	...

There was a highly significant negative correlation between Rosette and plant number, *i.e.*, where the stand was poor there was more Rosette.

Rosette Experiment.—The experiment of the previous season was repeated at 3 ft. by 1 ft. and 1 ft. by 1 ft. spacings with both types of groundnuts. The results were very conflicting, and there is nothing to add to the account given last year.

Plantation Crops.

Observations on Shea Nuts (*Butyrosperum Parkii*), Oil Palms (*Elaeis guineensis*), Tung Oil (*Aleurites Fordii*) and Chaulmoogra Oil (*Hydnocarpus Wightiana*) have continued through the year. There have been some additional plantings of the three former.

Acknowledgments.

In conclusion, I wish to acknowledge the valuable co-operation and assistance of Messrs. East African Ginneries, Ltd., Messrs. Liverpool Uganda Company, Ltd., Messrs Foster Bros., Ltd., and Messrs. Bombay Uganda Company, Ltd.

J. D. JAMESON,

Agricultural Officer.

PART IV.—BOTANICAL WORK AT KAMPALA.

Coffee.

A. SELECTION AND BREEDING.

Attention was devoted mainly to Robusta coffee, rather than to Arabica coffee, which is not now cultivated on so large a scale in the vicinity of Kampala: observations were continued on trees of *Coffea arabica* previously selected but no new selections were made. The term "Robusta coffee" is used to include all the types in that group: these coffees, even when wild, show great variation, and to different forms have been applied many different names, sometimes conferred by botanists who have never seen a coffee tree. It has become customary in Uganda to distinguish two main groups: (1) "Robusta" or erect trees, and (2) "Nganda" or spreading trees; the first class corresponds roughly with the progeny of seed from Java, and the second with native coffee trees. But there are exceptions—some Java trees are spreading and some native trees are erect in habit: and in any case most of the original "Robusta" coffee of Java must have come from Uganda or the Congo.

2. In the past, selection has been based largely on the size of the bean, as this was regarded as a very important character. But the premium received for a very bold type of Robusta coffee is relatively small, and it would seem most important to discover types which are outstanding for vigour and heavy bearing, providing that the bean is of good marketable size.

3. Observations were continued on the selections labelled three or four years ago, and it has been found that very few trees of the erect type have continued to flourish in native coffee plots near Kampala beyond an age of about six or eight years; in the Masaka district, where the standard of cultivation usually is higher, the trees may last longer. It has been found that there are a number of old spreading trees, aged from ten to over thirty years, which have flourished under native cultivation, and which, in spite of their large size and heavy bearing, yield beans whose size is above the average for Uganda. The average bean weight of a good sample of Uganda plantation Robusta F.A.Q. was found to be 0·137 gm., and that of good native Robusta F.A.Q. was 0·117 gm., the average bean weights of the selections made during the year lay between 0·130 gm., and 0·190 gm.—in which figures are included both large and small beans, for the samples were not graded as had been commercial ones.

4. The survival of these old "Nganda" trees appears to be due entirely to their spreading habit, which has two very beneficial effects—firstly, that the shade greatly reduces the temperature of the soil around the tree, and this is beneficial to root growth; and secondly, that it greatly reduces the growth of weeds and especially of grasses. There are few plants that can compete with grasses for a supply of Nitrates from the soil, and apparently it is by nitrogen starvation, consequent on the presence of grasses in quantity, that much erect Robusta coffee is killed, for the appearance of coffee bushes in neglected plots—the erect stems, crowned with a few short primaries, the pale leaves and the shrivelled berries—closely resemble the symptoms produced when coffee is grown in an artificial medium which is deficient in nitrogen. While the large trees are especially suited to native cultivation, they are worthy of trial on estates; it is not suggested that such trees will give a bigger crop per acre than will erect Robusta trees—the yields of some Uganda estates compare very favourably with those in any other part of the world—but it is probable that, by reducing cultivation, there will be secured a greater return per unit of labour, and that is a more important consideration.

5. During 1933, 29 trees were selected in Kyagwe, Kyadondo, Buddu, Sese and Toro; of these, only five were erect trees, the remainder having a spreading habit. The selected trees include a diversity of types, and attempts were made to discover if definite names were given to them, but it was found that many names were purely local. The following terms, however, are commonly used:—

Makonde—a spreading, small leaved tree, with pendulous primaries, the best type acclimatized on the Sese Islands.

Namata—a small, spreading type with very pale leaves, and with berries dull orange when ripe.

Musenzealanda—an erect type, the lower primaries very long, branching, and spreading over a considerable area, forming a conical tree.

As the trees are scattered, it is impossible to obtain records of the total yields of each one; the greatest amount taken from any selection in 1933 was 64 lbs. of coffee in parchment from No. 229, and the same tree shows promise of a good crop in 1934.

6. During the year seed from ten selected erect trees and ten spreading trees was supplied for planting in experiments at Bukalasa and seed of six selected spreading trees was supplied for trials at Wanyange; small quantities of seed of many of the selections were sown

at Kampala to supply plants for breeding trials and for demonstration plots. The remainder of the seed collected from selected Nganda trees was bulked and handed over for sowing in gombolola nurseries—50 lbs. for Busoga and 286 lbs. for Buganda.

7. The work of selection involved a considerable amount of travelling in Kyadondo and Kyagwe. A short visit was paid to the Masaka district in August, to look for good mother trees; safaris were made in Busoga and in Toro in company with the Agricultural Officers of the districts to investigate local conditions and to discuss the question of seed supply. As there was no Agricultural Officer at Masaka, a visit was paid to the Sese Islands in February to observe the progress of coffee cultivation; the erect type of Robusta coffee has proved to be unsuited to native cultivation there, but during 1933 there were planted out 30,000 seedlings raised from selected old trees of the "Makonde" type growing on Sese. Many new plots were made and a very real interest in coffee growing is being shown by some of the peasants, especially by those on some of the smaller islands.

8. At the beginning of the year, a short study of the effects of selection of Robusta coffee seed was made on trees on Mr. W. G. Poole's Kituza Estate. In one plot there are adjacent rows of coffee, one row raised from ordinary mixed seed, and one row the progeny of a tree with large cherries; from 20 trees in each row a sample of 20 berries was taken (a total of 400 of each type). The berries were weighed individually when fresh, and classified as in Table 1 and Graph 1. The berries were then pulped and fermented, the beans washed, dried, freed from parchment and weighed individually and classified as in Table 2 and Graph 2. The results appear to have considerable interest in that they demonstrate:—

(*a*) The increase in size of berry and of bean that may be obtained by sowing the seed from a large berried tree, instead of unselected seed—and this in spite of the fact that the male parent or parents were unknown.

(*b*) The great reduction in variability in the sample which may result from sowing the seed of one tree only; this is a feature of considerable commercial importance when it is remembered that the very small beans are often blackened and shrivelled.

TABLE 1.

WEIGHTS OF FRESH BERRIES.

Range in weight (grs.).	Number of berries.	
	Unselected Seed.	Selected Seed.
·40 — ·45	2	0
·45 — ·50	1	0
·50 — ·55	3	0
·55 — ·60	12	0
·60 — ·65	17	0
·65 — ·70	21	1
·70 — ·75	20	3
·75 — ·80	39	5
·80 — ·85	24	8
·85 — ·90	29	8
·90 — ·95	40	12
·95 — 1·00	25	12
1·00 — 1·05	20	18
1·05 — 1·10	23	26
1·10 — 1·15	31	29
1·15 — 1·20	15	34
1·20 — 1·25	16	29
1·25 — 1·30	18	31
1·30 — 1·35	21	31
1·35 — 1·40	15	25
1·40 — 1·45	13	25
1·45 — 1·50	6	22
1·50 — 1·55	7	22
1·55 — 1·60	10	15
1·60 — 1·65	5	24
1·65 — 1·70	3	15
1·70 — 1·75	1	15
1·75 — 1·80	1	11
1·80 — 1·85	0	9
1·85 — 1·90	1	11
1·90 — 1·95	0	0
1·95 — 2·00	1	1
2·00 — 2·05	0	0
2·05 — 2·10	0	1

TABLE 2.

WEIGHTS OF DRY BEANS.

Range in weight (grs.).	Number of Beans.	
	Unselected Seed.	Selected Seed.
·01 — ·02	4	0
·02 — ·03	9	0
·03 — ·04	3	0
·04 — ·05	3	0
·05 — ·06	2	0
·06 — ·07	3	0
·07 — ·08	9	0
·08 — ·09	24	1
·09 — ·10	43	0
·10 — ·11	82	8
·11 — ·12	62	20
·12 — ·13	90	29
·13 — ·14	94	49
·14 — ·15	69	59
·15 — ·16	89	92
·16 — ·17	68	107
·17 — ·18	55	117
·18 — ·19	38	86
·19 — ·20	29	67
·20 — ·21	16	61
·21 — ·22	9	41
·22 — ·23	2	33
·23 — ·24	2	32
·24 — ·25	0	20
·25 — ·26	0	13
·26 — ·27	0	8
·27 — ·28	0	1
·28 — ·29	0	0
·29 — ·30	0	1

9. The progeny rows on Plot 4, Kampala Plantation, which were raised from Mr. Liebenberg's selections, have been under observation throughout the year; individual tree records have been kept, and the weight of cherry and weight of bean of each tree have been measured. As many of the trees have only borne their first crop, it is impossible to draw definite conclusions and the measurements will be repeated during the current year. The cherry size and bean size of the progeny rows of the Kinawa coffee and the "Enoka" selection, planted on Plot 9B, Kampala Plantation, in 1926, have also been investigated, and the results are disappointing; the average bean weight of the original Kinawa trees was 0·193 gm., but the average bean weights of the progeny are all much smaller—ranging from 0·053 gm. to 0·184 gm.—the mean of 63 trees being 0·104 gm. Similarly, the average bean weights of the Enoka progeny varied from 0·055 to 0·168 gm., the mean of 83 trees being 0·108 gm.

10. The only decisive test of the value of any coffee selection is by the quality of its progeny, and therefore a small amount of seed of all the more outstanding selections was sown in beds to provide plants for progeny rows when sufficient ground is available. Some of these seedlings also will be supplied to the Senior Agricultural Officer, Kampala, for planting up the demonstration plots being laid down in Buganda.

11. Several attempts at self-fertilisation of Robusta coffee were made during the year, but met with no success. The small grafted trees were used for this work, as they could easily be enclosed in cages of mosquito netting; when the flowers opened, they were self-pollinated, using camel-hair brushes, but no fruit developed, and the study of this problem is being continued in the current year.

12. There were obtained from the Belgian Congo small amounts of seed from self-pollinated trees of Java selected clones. These seed were sown in the greenhouse and there were potted up the following numbers of plants:—

No. 59/10	...	... 14 plants.
No. 105/03	...	... 14 plants.
No. 83	...	... 21 plants.

B. VEGETATIVE PROPAGATION.

13. Recent work in Java has shown that the cultivation of grafted coffee has not been so successful as was anticipated, for the yields have been much lower than those of trees raised from seed. Therefore no grafting was done during the year, but observations were made on the grafted clones planted out in 1932. Owing to the different ages of the plants it is not possible to state which type of stock—*C. robusta*, *C. excelsa* or *C. liberica*—has produced the most vigorous trees, nor is it to be expected that definite results could easily be obtained, as work in other countries has shown that the problems of incompatibility between stock and scion in coffee grafting are very complex. The growth of the grafted trees at Kampala has been quite satisfactory—the average height of the different Robusta clones ranges from about 70 cm. to 140 cm., but it was observed that in April, when Leaf Disease (*Hemeleia vastatrix*) became noticeable at Kampala, the grafted trees were more badly attacked than were the other trees on the plantation. The grafted Arabica coffee trees also have grown well, and have an average height of about 120 cm., but two trees, which appeared to be quite vigorous, have suddenly died.

14. If cuttings of coffee could be successfully rooted there would be a method of vegetative propagation which avoided the problems of incompatibility of stock and scion. Batches of cuttings of young shoots of both *C. arabica* and *C. robusta* were inserted in the solar propagator at the beginning of the year, but were unsuccessful, with the exception of two cuttings of *C. robusta*, and further trials are being made.

C. EXPERIMENTS RELATING TO GROWTH.

15. In September, in collaboration with the Agricultural Chemist, there was started an experiment on the effect of different soil treatments on the growth of coffee. Five plots are under observation:—

(*a*) Robusta coffee, with cover crop.
(*b*) Robusta coffee, with weeds slashed.
(*c*) Robusta coffee, under mulch.
(*d*) Robusta coffee, clean weeded.
(*e*) Arabica coffee, under shade.

The Agricultural Chemist is investigating the soil differences, the botanical section is undertaking fortnightly measurements of leaf and shoot growth and observations on root growth, together with daily records of soil temperatures. One definite observation has been made—that during the dry season active root growth on all plots ceased, with the exception of the plot under mulch, where there were always some white roots. The soil on this plot appeared never to become so dry as did that of the other plots, and on some hot afternoons, the temperature (at a depth of two inches) under the mulch was as much as 10°C. lower than that of clean weeded soil nearby: while the maximum soil temperatures of the plot of coffee under shade (clean weeded) were lower than those of the clean weeded plot in the open. It is probable that these facts are of considerable significance, for it has been shown that an excessive soil temperature is often the limiting factor to plant growth in the tropics.

16. Another experiment on the habit and rate of growth of seedlings of Robusta, "Nganda" and Arabica coffee, was started in October and it is hoped that differences observed between these types will throw some light on their different reactions to the conditions under which they may be grown.

17. The phenomenon of "dud-budding" is one of the great difficulties of the cultivation of Arabica coffee in Uganda, and it has been suggested that it may be due to the meteorological conditions in some areas.

In order to investigate this point further, it has been arranged that daily records of the evaporating power of the air, as measured by a Piché tube, shall be kept in plots of coffee at Kampala, in Bunyoro, in Toro and in Bugishu; and thanks are due to Mr. D. N. Stafford, Captain H. M. Naylor and the Agricultural Officer, Bugishu, for their kind assistance in this matter. Preliminary trials with Piché tube at Kampala have shown that there are only relatively small differences between the records obtained from the tubes suspended at heights of two feet, four feet and six feet above the soil in any one place; and that the rate of evaporation among coffee under shade is always slightly below that among unshaded coffee.

D. LIQUORING TESTS.

17. At the beginning of the year a collection of samples of Nganda and Robusta coffee, prepared by different methods was forwarded to a firm in Mombasa for liquoring tests, these samples were sent under letters in order that there might be no bias, and the report stated that the Nganda coffee, sun dried in the cherry, was of better roast and cup quality than the Plantation Robusta coffee, which had been pulped and fermented in the usual manner. At the end of the year another collection of samples was prepared and was submitted to brokers in Nairobi, who placed the Plantation Robusta first. In the first report, Robusta fermented for 36 hours was rated above that fermented for 24 hours—and this order, too, was reversed in the second report.

18. Two samples of Nganda coffee from Sese, dried in the cherry and hulled, were despatched to the Imperial Institute for report. Sample A was a mixture from several trees, Sample B was from one tree, which produces a large proportion of peaberry. The merchants' report was:—

> "*A.* Fair average quality—even brownish Robusta.
>
> *B.* Rather bolder, but uneven size, light brownish, mixed pales. Both these coffees are worth about Shs. 45 to Shs. 47 per cwt., in London (in March, 1933). The presence of peaberries in Sample B has no material effect on the value. The coffees would find a fairly ready market here in the ordinary way, and it would be advisable to send a trial shipment at an early date."

The peculiar conditions of Sese are unsuited to many varieties of Robusta coffee, but these samples were from old trees of the "Makonde" type which has become acclimatized there, and it is gratifying to find that this produce will satisfy even the requirements of the English market.

19. Excelsa coffee is reputed to withstand drought better than does any other type, and in consequence might be suited to areas in Uganda which are too dry for Robusta coffee. Therefore there were prepared and submitted to Mombasa for test two samples of beans from the trees on the Kampala Plantation, but the reports were discouraging:—

> "Sample No. 1.—(Pulped, fermented and washed).
> *Liquor.*—The liquor is strong, hard and unclean.
>
> Sample No. 2.—(Sun dried in the cherry and hulled).
> *Liquor.*—The liquor is very unclean, hard and sharp, containing stinkers."

E. WILD COFFEE.

20. Several species of coffee grow wild in Uganda, including *Coffea excelsa, C. liberica, C. robusta, C. eugenioides*—the last two being the most widely spread, for they are to be found in the forests of many parts of the country—Buganda, Bunyoro and Toro. *C. eugenioides* (Nandi coffee) appears to be of no commercial value: it forms straggling bushes up to ten feet in height, and bears few fruits which contain very small beans. The wild *C. robusta*, on the other hand, is gathered in many places, for in certain areas it grows so abundantly as to be the dominant plant in the undergrowth. Wild trees have been inspected in the forests near Kampala, and visits were made to the forests in Toro to see whether the wild coffee showed promise of being valuable for breeding purposes. There is great variability in the wild forms, for example, the coffee in the Itwara Forest, Toro, is of an erect type, with long primaries, broad leaves, and relatively few fruits; while that in the Kibale Forest is of a more spreading type, with narrower leaves and larger clusters of fruits; in both cases the beans are of good size, being larger than those of most of the wild coffees seen near Kampala. Seed of the wild types has been sown in order that their value under cultivation may be tested. It was of great interest to observe that the wild robusta coffees were often growing in soils with a pH value of 5·5—6, and which appeared to be relatively infertile clays or coarse sands: and that the wild trees did not have a strongly marked taproot, but did possess strong spreading lateral roots arising near the level of the soil surface.

Tea.

21. A considerable amount of attention was given to the Assam Indigenous tea on Plot 32, Kampala Plantation. On the part which is being reserved for seed production, further rogueing of the poorer trees was carried out, and the remaining trees were pruned to improve their shape. The part which is being plucked was pruned drastically in July; this treatment, coupled with mulching and cultivation, has greatly improved the appearance of the plot. Towards the end of the year, seed from some of the best trees was sown to provide plants for filling in the blank spaces.

22. In August, a visit was paid to the plot of Kalline Manipuri tea at Buwunga, near Masaka; these trees were very crowded, and in order that the plot might be put in a good condition as a source of seed supply, 60 per cent. of the worst trees were marked for removal. In December, on the way to Fort Portal, a visit was paid to the plot of Assam Indigenous tea at Kakumiro, and a report was submitted. The seedlings of the jats imported from India in 1932 were potted up, prefatory to being planted out in the early rains of 1934.

Essential Oil Plants.

23. *Pelargonium* spp. (Scented Geraniums).—Throughout the year the work of propagation was continued, whenever material was available. As has been the case in other countries, a certain amount of difficulty was experienced in obtaining always a high proportion of rooted plants from the batches of cuttings. Various trials were made, and it was found that the best results were obtained from cuttings of fairly mature wood, inserted in nursery beds: treatment of the cuttings with a dilute solution of Mercuric Chloride did not produce any beneficial results, although the practice is followed elsewhere. Whenever there was a quantity of material sufficient for distillation, it was handed over to the Agricultural Chemist.

24. *Lippia Citriodora* (Lemon Verbena).—The size of the plot was increased by planting out many rooted cuttings; the old plants were cut back, the leaves stripped for distillation, and more cuttings of the woody shoots inserted in the nursery beds.

25. *Mentha* spp. (Mints).—The various types were replanted, and material handed over for distillation; by the end of the year the stock of *Mentha piperita* (Peppermint) had been greatly increased, but the plant makes poor growth at Kampala.

26. *Pogostemon patchouly* (Patchouly).—The report on the oil distilled from our existing stock of Patchouly suggested that it was a poor type, and that it would be advisable to procure a further supply from Singapore. In May, a consignment was imported; of the twenty plants that had been despatched, only seven survived; these were potted up, grown in the greenhouse and propagated as rapidly as possible.

27. *Polianthes tuberosa* (Tuberose).—In May and in November trials of enfleurage of tuberose flowers were made, by spreading them on cloths soaked in simsim oil. These trials showed more promise than did the tests with Frangipani in 1932, but it was found difficult to obtain an oil which initially was free from taint.

Fixed Oil Plants.

28. *Elaeis guineensis* (Oil Palm).—The routine records of individual tree yields at Entebbe were continued. The seed from the highest yielding trees, sown in 1932, has germinated well, and many seedlings will be available for planting out in 1934.

29. *Aleurites* spp. (Tung Oil).—In 1930 there were planted at Kampala nine *Aleurites Fordii* and one *A. montana*. Of the *Aleurites Fordii*, there remain seven, in poor health. They grew to about three feet in height and then branched, and the average height now is about four feet—the most healthy is five feet high, but three of them are showing a tendency to die back and to throw up fresh shoots from the base. The single *Aleurites montana* is very stunted and is only two feet high. It would appear therefore that neither species shows any promise of commercial value in conditions like those at Kampala.

30. *Ricinus communis* (Castor Oil).—In April a plot was sown with a collection of local types of castor oil; the plants were kept under observation and in October twenty plants were selected. The seed gathered from them was sown in progeny rows in November. The twenty selected plants could be divided into six main groups, but only two of the types show much promise of heavy yield. Most of them are showing little variation, but unfortunately one of the best types is segregating.

Fibres.

31. *Asclepias semilunata* (Kafumbo).—In March two plots of this plant were sown on the Kampala Plantation. Owing to the uncertain weather, the germination was irregular, but seedlings were transplanted to fill in the blanks. Subsequently the plants made good growth, and could have been spaced more widely than they were (two feet by one foot). The yield of floss was at the rate of nearly 1,000 lbs. per acre. Samples grown in 1932 received a favourable report from the Imperial Institute; therefore all the available seed was handed over for a trial of the crop on a large scale at Bukalasa.

32. *Musa textilis* (Manila Hemp).—Twenty suckers of true *Musa textilis* were introduced from Amani in May, and were planted out on the Kampala Plantation. Unfortunately, although they were planted and tended carefully, they did not grow well, and several died, but it is hoped soon to work up a stock from the remainder.

33. *Corchoris capsularis* (Jute).—Plots were sown, but the plants were very stunted. The cultivation of *Boehmeria nivea* (Ramie) also was continued and material supplied to the Assistant Agricultural Chemist for trials of extraction of the fibre by digestion.

Spices and Condiments.

34. *Coriandrum sativum* (Coriander).—Plots of both the round-seeded and the oval-seeded types were sown in April and in August, but the results were poor, largely owing to meteorological conditions; this crop does not show promise of much value in Uganda.

35. *Piper nigrum* (Black Pepper).—The young plants, raised in 1932 from seed imported from the Gold Coast were planted out in May. In order to facilitate any work of selection in the future, the seedlings were planted singly against Hevea rubber trees and will be trained up the trunks. Twenty-seven plants were thus put out against the rubber trees remaining on Plot 23, Kampala Plantation, and the remaining pepper seedlings—about 60—were planted among a plot of Hevea at the Botanic Gardens, Entebbe.

36. *Pimenta officinalis* (Allspice).—A packet of seed of Allspice, received from Ceylon, was sown in the greenhouse at Kampala and eight seedlings were potted up; seed of this plant has been introduced several times before, but this is the first time that any has germinated. Seed of *Pimenta acris*, obtained from Amani, failed to germinate.

Drugs.

37. *Hydnocarpus anthelmintica*.—In 1929 there were planted two plots, one of 36 trees at Entebbe, and one of 48 trees at Kampala. In both places the trees have grown well to a height of about 16 feet and are now commencing to spread; no fruits have been formed at Kampala, but by the end of the year one or two trees at Entebbe had commenced to bear.

38. *Hydnocarpus Wightiana*.—The 36 plants on the plot at Entebbe have formed spreading bushes, about 11 feet high, and many are commencing to ripen fruit. The large plot of 204 bushes, planted at Kampala, is more vigorous, the average height of the plants being 12 feet, and many are fruiting heavily. Records of individual trees are included in the report upon the Government Plantation, Kampala.

39. *Picralima Klaineana*.—A sample of 14 lbs. of seed was prepared and forwarded to the Imperial Institute.

40. *Chenopodium ambrosioides* var. *anthelminticum* (Wormseed).—In April a plot was sown, but the germination was irregular: however, from the existing plants there was collected sufficient fruits for a sample of three lbs. to be forwarded to the Imperial Institute for report. The report stated that—

> "The sample consisted of three lbs. of fruits of normal size and appearance.
>
> With reference to the possible utilisation of these fruits in the United Kingdom, essential oil distillers who were consulted stated that there is no market here for the material for the preparation of the oil, whilst a firm of wholesale druggists reported that only small supplies are imported from the United States and realise about 4½d. per lb. There is, however, a growing demand for the oil, the current price of Chenopodium oil in London being 10s. per lb. *c.i.f.*, and it seems likely that if no serious increase of production takes place in the United States, Empire produced oil, fulfilling the requirements of the British Pharmacopœia, should find a regular market if offered in moderate quantities."

In order that a large area might be planted in 1934, to provide a quantity of material for distillation, all available seed was collected. As mentioned above, owing to the small size of the seed, germination in the field was poor: trials of transplanted seedlings were a failure—the seed grew well in nursery beds, the seedlings grew after transplanting, but remained very stunted and did not attain the vigorous bushy habit of plants grown from seed sown *in situ*.

Green Manures.

41. A collection of green manure crops was sown on the Kampala Plantation in April, kept under observation and the average height and spread were measured once a fortnight. In Table 3 below there are summarized the following particulars:—

(*a*) *Days before germination*.—This figure is of importance as it appears that the action of cover crops in preventing soil wash is as valuable as their manurial effect, and for the former purpose it is essential that they should germinate quickly.

(*b*) *Measurement of the height and the spread* of the plants after two weeks and after four weeks; this is included to show the rate of growth of the plants, for it is of importance that a green manure crop should soon cover the ground and be able to compete with weeds. No one wishes to expend much time and labour on the cultivation of cover crops.

(*c*) *Weeks before flowering*.—This gives an indication of the time at which the crop will be ready to be dug in, usually a few weeks after the start of flowering, before any seeds are formed. This consideration does not apply in the case of perennial crops, *e.g.*, *Centrosema* spp.; and the period of vegetative growth of other species, *e.g.*, *Cajanus indicus*, may be prolonged by cutting them back.

(*d*) *The height and spread of the plants* at the time of flowering is included to give an idea of the relative bulk of green material produced.

TABLE 3.

NAME.	DAYS before germination.	WEEKS before flowering.	SIZE IN CMS. AFTER 2 Weeks. Height.	2 Weeks. Spread.	4 Weeks. Height.	4 Weeks. Spread.	Time of flowering. Height.	Time of flowering. Spread.
Crotalaria juncea (Bukalasa)	3	7	14	14	53	24	105	30
Crotalaria juncea (Nagpur)	3	6	16	14	56	23	90	27
Crotalaria juncea (Cawnpore) ...	3	6	16	16	55	21	85	26
Crotalaria alata	6	10	1	2	2	7	26	25
Crotalaria intermedia	4	9	5	6	10	14	70	74
Crotalaria invantulensis	17	8	...	...	5	6	17	27
Canavalia ensiformis	6	9	6	26	11	45	40	62
Vigna unguiculata	5	8	9	16	11	30	16	58
Dolichos lablab	5	8	6	18	12	28	38	68
Centrosema pubescens	9	14	2	5	3	11	7	70
Centrosema plumieri	9	14	2	6	4	23	21	91
Indigofera anil	14	11	3	5	6	4	32	19
Mucuna pruriens	12	16	4	11	23	39	52	445
Sesbania macrantha	10	20	2	5	6	11	240	130
Cajanus indicus	7	14	7	10	15	15	108	53
Phaseolus calcaratus	5	15	9	11	10	20	40	95
Phaseolus lunatus	5	9	5	13	7	20	31	130
Clitoria cajanifolia	31	?40	...	...	...	...	60	30

42. Some of the plants, *e.g.*, *Crotalaria invantulensis*, *Indigofera anil* and *Clitoria cajanifolia* are very slow to germinate, and grow little in the first two months. These characters greatly increase the cost of cultivation and it would seem scarcely to be worth while to cultivate such crops. The same drawbacks were found in the case of a series of native plants which have been tried on a small scale, and whose growth has been very slow; these plants included:—

Crotalaria cleomifolia.
Crotalaria striata.
Crotalaria lachnocarpioides.
Crotalaria natalita.
Indigofera secundiflora.
Teramnus sp.
Trifolium Johnstoni.

None of the cover crops introduced in 1932 from Tanganyika—*Coronilla varia*, *Lespedeza sericea*, *L. striata*, *Clitoria cajanifolia*, *Puereria thunbergiana*—have made good growth at Kampala.

43. Two other native Crotalarias appear to be of more value—*Crotalaria recta*, which is rather slow in growth, but yields a good bulk of material, and *Crotalaria agatiflora* which might be of use as a permanent sub-shrubby cover. The native *Tephrosia vogelli* and *T. barbigera* also may be useful. *Sesbania aegyptiaca* (Mubimba) was also grown; the value of this plant as a temporary shade is well known, and it is already planted on several estates in Uganda, lasting from four to seven years. In Kenya it is not always regarded with favour, as it is said that its roots compete too much with those of coffee trees. *Smithia Kotschyi* (Mpoja) which appears to be more deep rooting, was also tried; but its growth was found to be so slow as to render it of little value.

44. *Crotalaria juncea* (Sunn Hemp), showed itself to be one of the most useful green manure crops, in that it germinated rapidly and soon produced a large bulk of material. There was found to be considerable variation between individual plants, but the Bukalasa strain grew more strongly than did either the Cawnpore or Nagpur types. Therefore twenty plants of the Bukalasa type were selected on the basis of vigour, leafy character and branching habit. In September the seed of these plants was sown in small blocks, and from the resulting plants twenty selections again have been made; it is hoped that soon a type of a definitely stronger habit and a more leafy character will be segregated.

Grasses.

45. The collection of grasses at Kampala was maintained, and there were added to it a few other species which are of value for grazing, including *Brachiaria decumbens*, *B. Kotschyana*, *Axonopus compressus*, *Chloris gayana*. Assistance was given to the Chief Locust Research Entomologist in the identification of the grasses encountered in his studies of the habitats of locusts and grasshoppers.

Fruit Trees.

46. *Citrus*.—The budded trees of various Citrus varieties, imported last year from Ceylon, were planted out, sixteen at Kampala and eight at Entebbe. There were raised at Entebbe a considerable number of seedlings of Sour Orange and Rough Lemon, which will be grown to provide stocks for the increase by budding of the good types of Citrus now growing at Kampala and Entebbe.

47. *Carya pecan* (Pecan Nut).—Of the fourteen grafted Pecan trees, imported from Natal in November, 1932, and planted temporarily near the nursery at Kampala, three have died (one Schley, one Moneymaker, one Success). At the beginning of September there were forwarded to Bukalasa one tree of each of the three varieties—Moneymaker, Stuart and Success; similar trees were planted at Entebbe, and the remainder put out in the fruit plot, Kampala.

Introductions.

48. The plants introduced during the year included:—

Pimenta officinalis (seed) from Ceylon.
Pimenta acris (seed) from Amani (failed).
Three Java Robusta coffee selections (seed) from Belgian Congo.
Patchouly plants from Singapore.
Manila Hemp suckers from Amani.
Seven varieties Sugar Cane (Cuttings) from Natal.

A. S. THOMAS,
Assistant Botanist.

PART V.—ANNUAL REPORT ON THE BOTANIC GARDENS, ENTEBBE, 1933.

Meteorological.

Meteorological records have been supplied by the British East African Meteorological Service. The total rainfall—58·08 inches—was 1·50 inches less than the average of 33 years. The wettest month was May, when 9·30 inches were recorded, this figure being 0·12 inches below the average for that month. November was the driest month, when only 1·55 inches of rain were registered, a record 3·21 inches below the average. The second rains were very uncertain, October and November being unusually dry months, in consequence the planting of many newly introduced plants had to be deferred.

Oil Palms.

2. The routine work of cutting the grass in the Oil Palm plot and of recording the yields of individual trees was continued. The average number of fruits collected per month was 10,801 and the average weight per month was 382 lbs. 13 ozs., the greatest yield was in July, when 16,548 fruits, weighing 646 lbs. 13 ozs., were harvested.

Cacao.

3. The plots were weeded at frequent intervals throughout the year in order to eliminate "Lumbugu" (*Digitaria abyssinica*) and "Nanda" (*Commelina* sp.), and a mulch of dead leaves and grass was given. The Grevillea trees which had been planted to give shade are not in a good state of health, and it is proposed to replace them; in March there were sown at stake clumps of "Mubimba" (*Sesbania aegyptiaca*) which in a few months had grown sufficiently to afford temporary shade; in September there were planted out seedlings of *Albizzia stipulata* which are to grow into permanent shade trees.

4. Owing to the depredations of monkeys and squirrels, which gnaw holes in the pods and remove the seeds before they are ripe, it was found to be impossible to obtain accurate records of the yields of the plots; these records therefore have been discontinued. But it is intended to maintain the plots of cacao as they are of interest to demonstrate the growth of the plant in Uganda. Records have been kept over so long a period that the relative values of the trees are known, should material for planting be required.

Rubber.

5. Investigational work on rubber was stopped in 1931 and many of the Hevea trees have been removed; some have been retained, however, and are to be used as supports for Pepper (*Piper nigrum*). In May about 60 pepper seedlings (raised from seed imported from the Gold Coast) were planted out, one to each rubber tree; these were not sufficient to cover all the trees, and against the remaining trees there were planted cuttings from a pepper plant introduced some time ago.

Hydnocarpus.

6. Both *Hydnocarpus Wightiana* and *H. anthelmintica* have grown well during the year. The former has commenced to ripen fruit in quantity, while by the end of the year there were a few ripe fruits on the *H. anthelmintica*.

Fruit Trees.

7. A considerable number of new species and new varieties of fruit trees have been imported in recent years, and it was necessary to obtain an area on which they could be planted. Accordingly, in June there was commenced the clearing of the land above the plot of *Hydnocarpus* spp. Some of this land was under rough scrub and grass, and some had been utilised for native plots of Sweet Potatoes and Cassava; in consequence, a great deal of labour was required to dig out the Lumbugu and to level the plot. In August a crop of Pigeon Pea was sown to cover the ground until the rainy season of 1934, when grass will be planted. In October and November the other piece of land lying between the town drain and the road was cleaned and levelled in a similar manner and in December it was planted with a cover crop of *Dolichos lablab*. The poorer trees on these plots were removed, and some of the *Eugenia Cuminii* were cut out as they obscured the large *Cassia javanica*, while others were kept as specimens. The group of "Nongos" (*Albizzia* sp.) were retained to act as supports for a collection of *Passiflora* spp. and *Tacsonia* spp.

It is intended to arrange the fruit trees on these plots in groups, according to their genera.

Nursery.

8. The preparation of the new nursery proceeded throughout the year: the tree stumps were removed, the ground was levelled and cleaned and catch crops of Sunn Hemp (*Crotalaria juncea*) and Niger Oil (*Guizotia abyssinica*) were planted. The Agricultural Chemist examined the soil, and reported that it would be improved by the application of lime, one dressing of which was given. In July, the paths and beds were marked out and the construction of stone edges to the beds was commenced. In September and October two houses—one for plants, and one for packing materials—were built and thatched with "Lusenke" (*Imperata cylindrica*). A plot of about 600 "Nsambya" (*Markhamia platycalyx*) was planted adjacent to the nursery to supply the poles needed for the construction of shades.

9. Throughout the year, the distribution of plants from the old nursery was continued: during April, when fruit trees are supplied free of charge, there were sent out the following:—

Avocado pear	26	Loquat	63
Blackberry	45	Mango	83
Bread nut	41	Mulberry	47
Carambola	11	Nsali	35
Golden apple	42	Orange	182
Grape fruit	99	,, mandarin	39
Guava apple	23	,, marmalade	35
,, cherry	55	,, tangerine	137
,, common	29	Pawpaw	68
,, Friedricthalianum	24	Pomegranate	7
,, strawberry	29	Pomelo	53
Jack fruit	75	Pineapple	32
Lemon—rough	96	Pitanga cherry	74
,, smooth skin	76	Raspberry	90
Roseapple	84	Tree tomato	67
Soursop	42		
Lime	45	Total	1,854

Seeds.—Cape Gooseberry, 3 packets; Pawpaw, 2 packets; total—5 packets.

10. The total number of plants and seeds distributed during the year amounted to:—

	Plants.	*Seeds (packets).*	*Bundles.*
Economic	4,284	6	—
Decorative	4,623	48	9
	8,907	54	9

Fernery.

11. In March the fernery was extended on the east side of the road by the spring; the coarse undergrowth was cut out and some of the trees were removed. At different times throughout the year there were planted out in this new area a considerable number of species which flourish in partial shade, including a collection of ferns from the Sese Islands, various native *Scitamineae*, *Haemanthus multiflorus*, *Musa* sp. (*? M. ensete*), *Coix Lachryma*—Jobi, *Richardia africana*, *Sinningia speciosa*. The fernery was also extended on the south side, by planting seedlings of various native trees: access on the west side was facilitated by interposing more steps in the existing flight: and there were removed many of the seedlings of the Toddy Palm (*Caryota urens*) which is becoming naturalised in the fernery to the exclusion of native plants.

Lawns.

12. It has been observed that French Grass (*Cynodon dactylon*) which has been used to form most of the lawns in the gardens, is not altogether satisfactory: at first it grows so rapidly that it is difficult to cut with machines, but after a year or two it gradually decreases and its place is taken by coarser grasses and weeds. This phenomenon may be due to a special sensitivity to nitrogen deficiency, a supposition which is supported by the fact that applications of ammonium sulphate will stimulate a strong growth of French Grass in places where before it was quite inconspicuous.

13. Small plots of various grasses were laid down by the new nursery to test their value for lawns: these grasses included:—

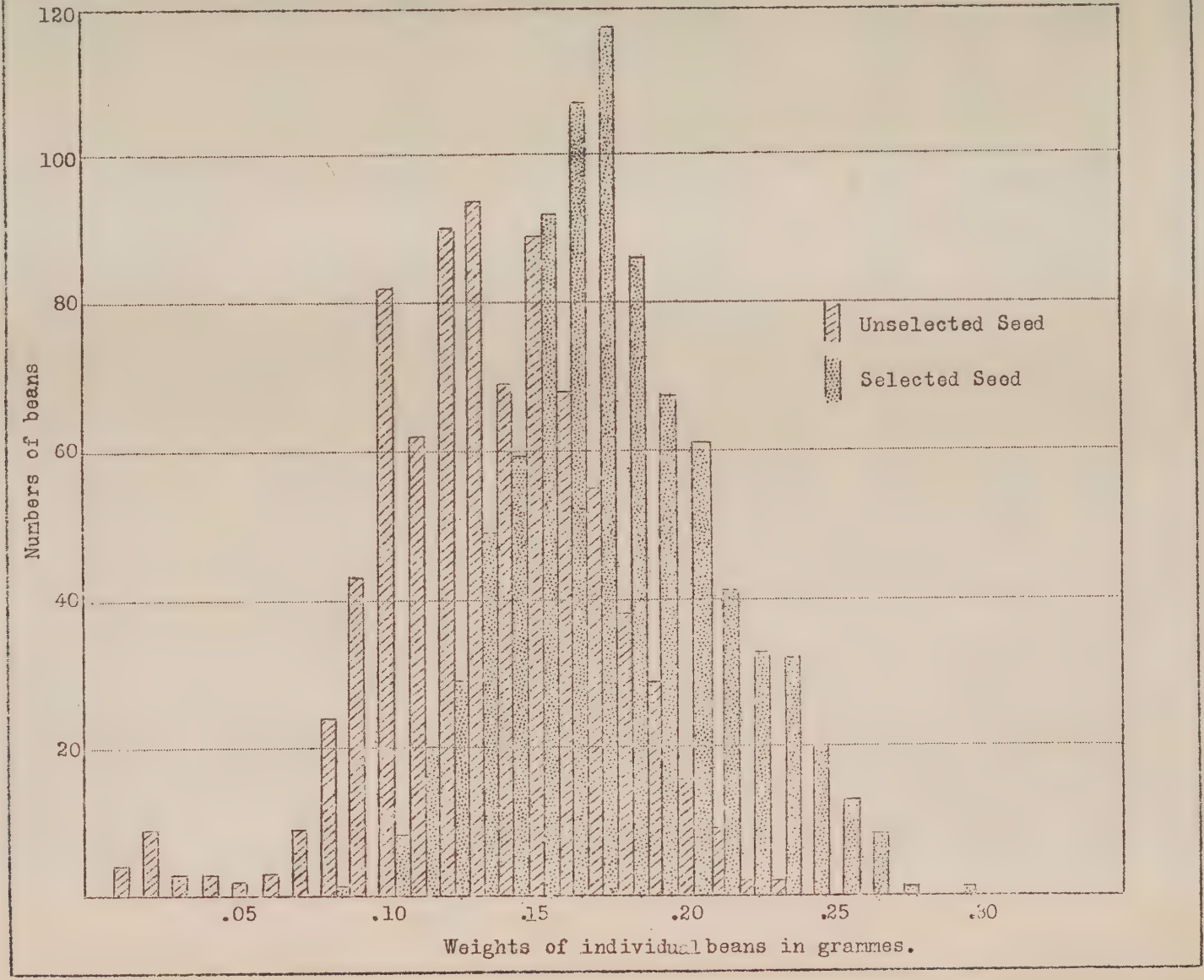
Cynodon Dactylon (French Grass).—Quick growing, and will soon cover the ground; but, as mentioned above, it tends to die out quickly.

Cynodon transvaalinicium (Masindi Grass).—In spite of its fine leaves and dwarf habit, this grass spreads rapidly and in a few months it forms an excellent lawn, but after about two years it often becomes lumpy and dies out in patches: probably if it is cut short and given top dressings, it can be kept in good condition for a longer time.

Chloris pycnothrix.—This grass can readily be grown from seed, and can exist on poor soil; it forms a thin greyish turf.

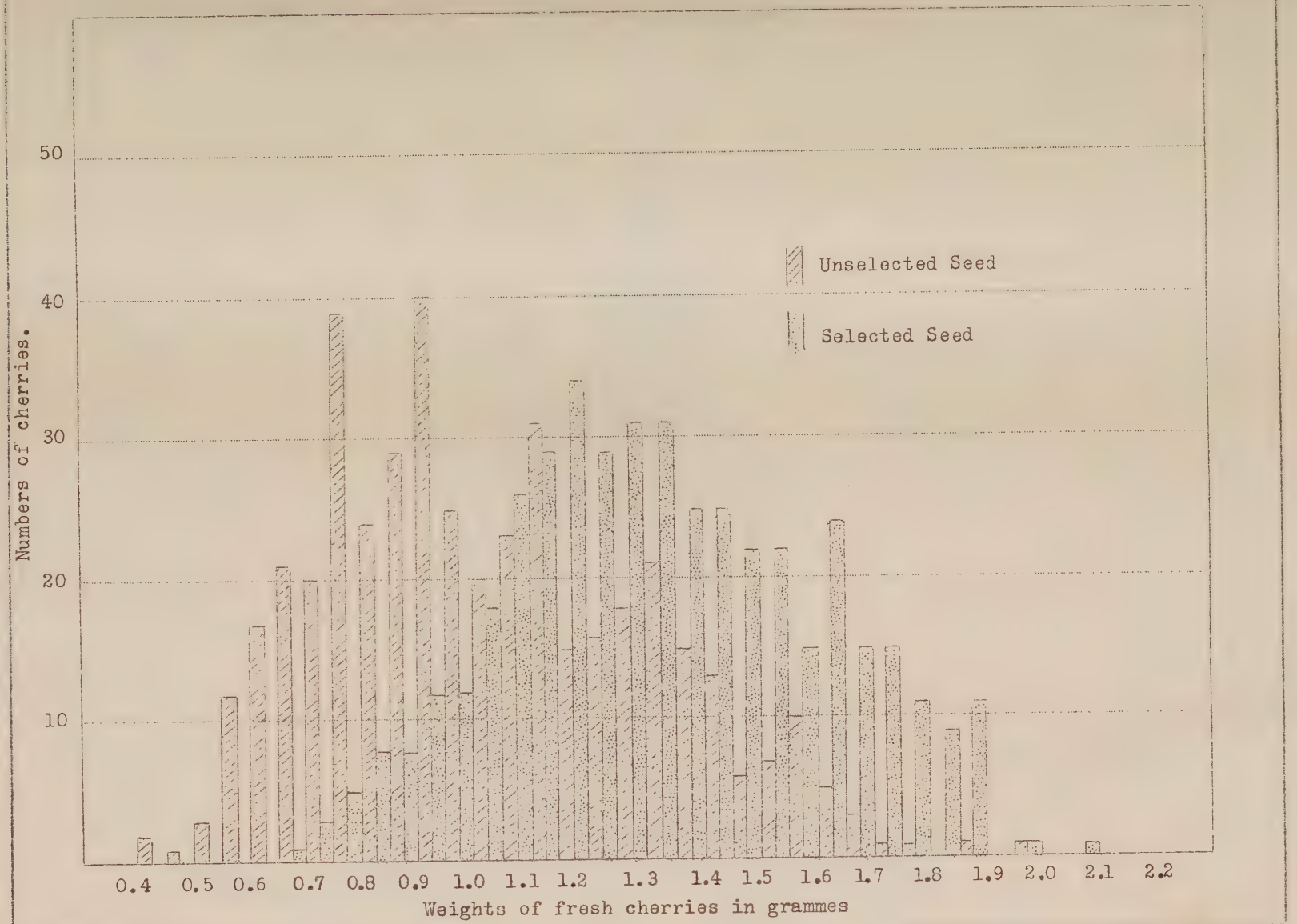
Eragrostis Mildbraedii.—A native grass which comes into lawns at Entebbe: it has small leaves and withstands drought; its chief defect is that the stems are so wiry that they are not cut short by a machine and that periodically it must be clipped by hand.

GRAPH 2. WEIGHTS OF DRY BEANS



GRAPH 1.

WEIGHTS OF FRESH CHERRY.



Brachiaria decumbens.—This grass, found in many drier areas of Uganda, after planting makes a coarse mat of stems and leaves; but it is hoped that in time it will form a close turf, as it does in its natural habitat when heavily grazed.

Axonopus compressus (Savannah Grass).—This is frequently used for lawns in other parts of the tropics, and is native to Uganda, being common on the Sese Islands. It cannot stand dry conditions, but is useful in moist places, especially under shade, where it flourishes.

Paspalum notatum.—An introduced grass, which after planting at first is rank, but which may be cut to form a coarse turf, and will withstand drought.

Pennisetum clandestinum (Kikuyu Grass).—At Entebbe the growth is very rank, but in the cooler parts of the country, *e.g.*, Bugishu and Kigezi, it forms excellent turf.

14. The grass on the existing lawns was kept down by machines for most of the year, with the exception of the first rainy season, when some had to be cut with sickles. In some places the appearance of the lawns was much improved by weeding and cutting out turfs of coarse grasses (*e.g.*, *Panicum maximum*).

15. During the year, considerable areas of ground were cleared preparatory to making lawns—the new fruit plots at the top of the garden, and the waste land near the old nursery also was dug up, for, as the nursery is being shifted, there is no need to reserve it as a parking place for cars. One new lawn was planted—the sloping plot above the new nursery; clearing and levelling were carried out at the beginning of the year, and the ground fallowed to facilitate weeding. In September the plot was planted—the upper part with French Grass (*Cynodon Dactylon*) and the sloping stony part with *Brachiaria decumbens.*

Decorative Plants.

16. It is hoped that, in future planting, it may be possible roughly to group the species according to their families. Therefore the newly cleared sloping plot above the nursery will be kept mostly for Coniferae; the existing group of Cupressus trees has been retained, and its area somewhat increased by planting more *Cupressus macrocarpa* and *C. lusitanica* seedlings. On the newly made lawn there have been planted 3 *Callitris calcarata*, 3 *Callitris rhomboides*, 3 *pinus* sp.; a group of *Casuarina equisetifolia* was planted near the road to act as a screen from the untidy ground outside the boundary of the gardens. Seven more *Cupressus pyramidalis* were planted near the existing group on the top of the slope nearby.

17. The depression in the main lawn already contained some specimens of palms and it is intended that more plants of this type should be grown there. Some of the palms growing on the lawn in the vicinity were arranged in groups, and other species were added, including *Areca concinna*, *Caryota urens*, *Chrysalidocarpus lutescens*, *Oreodoxa oleracea* and the native *Phoenix reclinata* and *Borassus flabellifer.*

18. On the large lawn made last year various groups of plants are being grown; near the fernery there were planted a number of *Erythrina* spp.—*E. tomentosa*, *E. glauca*, *E. sereti*, *E. corallodendron*, *E. lithosperma*, *E. micropteryx.* In another corner were placed a number of trees of the family Meliaceae, including 5 *Carapa grandiflora*, 1 *Cedrela australe*, 3 *Cedrela toona*, 3 *C. odorata*, 5 *Melia azadarachta;* and in another corner a group of coffee species was made, including *C. excelsa*, *C. liberica*, *C. robusta*, *C. arabica*, *C. eugenioides*, and *C. stenophylla.*

19. Other decorative and economic trees and shrubs placed in various parts of the garden included 5 *Sterculia acerifolia*, 3 *Leptospermum* sp., 1 *Bolusanthus speciatus*, 1 *Peltophorum* sp., 3 *Myroxylon toluiferum*, 3 *Brownea ariza*, 2 *Schizolobium excelsum*, 1 *Pycnostachys thyrsiflora*, 1 *Bougainvillea spectabilis* var. *brasiliensis*, 1 *Bignonia Chamberlayni.*

20. Near the fernery a border was made in which are to be grown bulbous and tuberous plants and various members of the order *Scitamineae;* groups were planted of many of such plants already cultivated in the gardens including *Crinum* spp. *Iris* spp. *Zephyranthes* spp. *Kniphofia* spp. *Lilium regale*, *L. longiflorum.* Other plants, hitherto not represented in the gardens, were added, including *Alstroemeria haemantha*, *Hemerosallis aurantiaca*, *Watsonia rosea*, *Strelitzia augusta.*

Roads.

21. A great deal of labour was expended on the roads in the gardens, both on the construction of new ones and on the repair of those already in existence; for many of the old roads were too narrow to allow the passage of two motor cars, and therefore they were widened to eighteen feet—twenty feet would have been preferable, but this distance was not feasible in many places. The most important new road made was the one down the north side of the gardens, from Berkeley Road to the lakeshore; on the higher ground this road follows the town drain, while on the lower part it goes past the large bamboos, further clumps of which were planted to form an avenue. From this new road three branch roads were made to join up with the old road from the top of the gardens to the nursery.

22. The latter road was regraded and widened throughout its length; the road through the fernery and up the slope towards the Secretariat also was remade. The road to the south of the existing block of para rubber was repaired, and the narrow part was widened. The steps near the cacao plot were removed and the road graded to allow the passage of motor cars. At this point the view of the lake was reopened by removing a mass of scrub and laying down grass.

23. Many concrete culverts were purchased and put in place, notably in the drains crossing the road alongside the lakeshore. This road was weeded and repaired and in June, when a concrete bridge had been built over the main drain, the road was reopened after a lapse of many years. Wooden culverts under many of the other roads were replaced with concrete ones, and many of the stone drains beside the roads were repaired or rebuilt. During the greater part of the year one mason was employed continuously on this work, and, as there was so much to be done, a second mason was engaged in October.

Introductions.

24. The number of species of plants commonly grown in Uganda is very small in proportion to the quantity which should flourish in our climate, and an effort was made to introduce many which were considered to be of potential economic or decorative value. Several batches of seeds from other countries were sown, including 24 species from Mexico, 32 species from the gardens at La Mortola, Ventimiglia, Italy, 5 species of Australian plants, 8 species purchased from Amani, and 11 species of Aloes from Rhodesia. A total of 89 species or varieties of trees, shrubs and flowering plants was obtained from Kenya by presentation, exchange or purchase; owing to the uncertainty of the second rains, it was not possible to plant out many of these introductions, and they were potted up to await the early rains of 1934.

25. Thanks are due to several residents of Uganda who have generously presented seeds or plants from their gardens, and also to the following:—

Thomas Hanbury, Esq., La Mortola, Italy.

Prof. Juan Balme, Mexico.

Major Chater Jack, Kitale, Kenya.

The Conservator of Forests, Kenya.

H. B. Cristian Esq., Southern Rhodesia.

A. S. THOMAS,

Assistant Botanist.

REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR 1933.

In accordance with instructions received, the report on entomological work of medical interest is to be included in the Annual Report of the Medical Department.

2. The year has been remarkable for the comparatively small damage by insects to the cotton crop. In the case of *Lygus*, *Helopeltis* and stainers, this reduced damage appears to have directly correlated with the abnormally low rainfall.

Cotton.

3. The outstanding development of entomological interest has been the wide extension, to the south and east, of the area infested by pink bollworm of cotton; the first indications of this extention were discovered late in the season during examination of bolls for the estimation of the relative proportions of damage caused by various insects. A survey to determine the limits of the infestation was immediately concentrated upon, and this work was considerably expedited by the assistance afforded by Mr. H. D. Nangpal and, to a less extent by Mr. Bredo, both of whom were visiting Uganda at the time.

4. The evidence obtained from the survey indicates that movement of seed cotton, for ginning, to places distant from the source has been the chief cause of the wide infestation by pink bollworm. Investigations have been directed towards the elucidation of facts of practical value in control of the pest. These include alternative food plants; the occurrence of resting larvae and duration of the resting period under the wide variety of climatic conditions; parasites; and cultural and ginning considerations which affect survival of the pest during the period between cotton growing seasons. The attention of the Assistant Entomologist since his return from leave has been almost entirely devoted to the study of these aspects of the problem.

5. Special stress has been laid on the great importance of the rigid enforcement of a close-season for cotton, including the elimination of volunteer plants.

6. The advisability and the practicability of heat-treatment of seed by machines for killing pink bollworms resting in seed for sowing are being investigated. The successful employment of such a control measure depends, in general, on the relative importance of the larvae in such seed and of the survival of the pest by other means between seasons.

7. The question of alternative food plants of the cotton *Lygus* has received further attention. Immature stages of *Lygus* (and, incidentally, of other Capsidae) have been reared from both crops and wild plants. Other calls on the writer's time have so far given no opportunity for the careful examination necessary to distinguish the *Lygus* species (of which there appear to be at least two) on cotton from the closely allied species occurring on various other plants.

8. Inquiry into the oviposition habits of the cotton *Lygus* so far indicates that the condition of the plant is a very important factor: very soft tissues are essential for the successful insertion of eggs into the plant; the distal quarter-inch of the petiole and the base of young bolls appear to be the parts most favoured for insertion of eggs.

9. A spraying experiment designed to determine quantitatively the damage caused by *Lygus* to cotton at Kampala proved a failure owing to the almost complete absence of the insects on the control plots. The plants were late-sown.

10. Another experiment designed for the same purpose but using cotton plants grown in tubs, also failed. In this case two isolated groups of late-sown plants on a lawn were employed without cages, one group being continually supplied with *Lygus* and the other receiving no treatment. In the former case the adult insects failed to stay on the plants and little damage, caused chiefly by nymphs, resulted; in the other case the plants remained free from *Lygus*. All the plants made good growth despite, or perhaps because of rather dry weather conditions.

11. Examination of large numbers of boll-samples was undertaken to determine the relative importance of the insects which damage the cotton boll. The results shew that, even during a season markedly unfavourable for cotton insects in general, the total loss from such boll-feeders is of the order of 10% to 20% of possible crop (this estimate does not include the shedding of bolls and of flower-buds caused by *Lygus* and *Earias*). By far the most important of the losses included in the above estimate is that caused by boll-rots following on attack by stainer-bugs, and such damage is more extensive in the more humid areas.

12. Coincident with very dry weather conditions, intense attack by a Trombidiid mite (which feeds on the lower surface of cotton leaves, covering them with silk webs) was noted on weak plants growing in worn-out shallow soil. Plants in deeper soil in the same plot were not attacked. Although this insect appears to be of little importance, the observation gives further indication of a correlation of the health of the plant with attack by sap-feeders.

Coffee.

13. For the purpose of advising on insect pests of coffee and for the investigation of the incidence of such pests, twenty-four visits were paid to non-native owned estates.

14. The additional coffee plants required for the experiment outlined in the Government Entomologist's report (Agricultural) for 1932 p. 53 paragraph (*h*) were put out personally by him. With assistance from the Agricultural Chemist and the Agricultural Officer in charge of the plantation, he also made detailed notes on each individual coffee plant, descriptive of its condition with regard to type, development, health, crop, and the incidence of insects and diseases. The plants (*arabica*) of this plot exhibit very marked variation in type and they indicate the necessity for making due allowance for possible mixture of strains in all plot experiments with *arabica* coffee. Late in the year all surviving plants in this experimental plot were reduced to single-stem growth.

15. Specimens of *Prorops nasuta*, which parasite was introduced during 1932 into Bwamba for control of *Stephanoderes* in native-grown *robusta* coffee, were recovered without difficulty during 1933, thus showing that the introduction had been successful.

16. Other coffee insects on which advice was sought and assistance given, included:— *Gonocephalum simplex* Fab., *Jamesonia* sp., *Stephanoderes hampei*, Ferr., *Dirphya princeps*, Jord., *Bixadus sierricola*, White, *Pseudococcus lilacinus* Ckll., *Ps. citri*, Risso (root form), scale insects, *Lycidocoris mimeticus*, R. & P., *Antestia faceta*, Germ., and *Cephanodes hylas*, Linn.

Other Crops.

17. Examination of tea in the main tea-growing areas shewed that this crop is, as yet, remarkably free from insect pests. *Helopeltis*, though of general occurrence on tea has so far caused negligible damage and this mainly to seedling plants growing under somewhat crowded and unnatural conditions in nurseries.

18. Experiments to test the baits (South African formulae) for fruit flies, and for fruit-piercing moths which attack and cause the rot of orange, grape-fruit, pawpaw, fig and peach, gave curious results. The fruit-fly bait failed to attract any of the pests, while the moth bait attracted a number of various species of fruit fly. The failure to attract such moths may have been due to the absence of these pests during the very dry conditions of the period of the experiments.

19. Some work was carried out on a Lamiid borer (not yet identified) of orange trees. This insect mines the bark of the trunk going into wood a short distance to pupate. The attacked trees were over 20 years old and suffering severely from the effects of a bark disease.

Other Advisory Work.

20. Advice was sought regarding the following:—

Insects in maize meal;
Beetles boring in book shelves;
Cathorama herbarium, Gorh., beetle boring in books and papers;
Acraea acerata, Hew. and *Herse convolvuli*. Linn. (caterpillar), and *Cylas* spp. (weevils) on sweet-potato;
Sphingid caterpillars on *Gardenia;*
Fruit-sucking moths on orange, peach, fig and grape-fruit; *Epilachna similis*, Thunb. (beetle) on rice;
Zonocerus variegatus, Linn. (grasshopper) on sweet-potato and *Eleusine* millet;
Millepedes at roots of tea seedlings and tobacco.

Locusts.

21. The infestation by *Locusta migratorioides* has continued but with markedly diminished intensity. Damage to crops has been local and negligible. Where necessary for direct protection of crops beating and, to a less extent, burning have been employed to control hoppers. The locust situation was reported on each week and month until the end of March, since when, in view of the reduced activities of the pest, reports have been made to cover monthly periods.

22. Towards the end of the year one swarm of the Red Locust (*Nomadacris septemfasciata*) was recorded in the south-west of the Protectorate. A small scattered laying occurred; the hopper period was much protracted and later stages exhibited colouring typical of the solitary phase; very few fliers developed, reduction being effected largely by birds. This is the first record of breeding of this locust in Uganda.

23. Mr. H. B. Johnston, Chief Locust Investigator, arrived at the beginning of the year, and accommodation was provided for him at the laboratories.

Bee-Keeping.

24. Since his return from leave in August the Laboratory Assistant has spent such time as has been possible on further experiments with hives and on instruction of interested natives both at headquarters and in the districts. Among those who received instruction at headquarters or Bukalasa were twelve Gombolola Chiefs from Busoga, the Makerere College students in agriculture, two Agricultural Instructors, and a master of King's College, Budo, who wished to instruct his students in bee-keeping as a hobby.

25. The Laboratory Assistant paid a visit to Nakasongola (Buruli) and demonstrated the construction, use and advantages of the two-chambered native type hive to a meeting of the chiefs of that county kindly convened by the District Commissioner, Mengo. By the last-mentioned officer, arrangements were made for the supply of queen-excluders from Lukiko funds for sale to natives of Buruli. Further demonstrations, including extraction of honey and preparation of wax were given at Busana (Bugerere) where experimental hives of the new type had been placed in the previous year. A demonstration of the hive and of the preparation of wax was given at Kabale to chiefs of Bukiga county.

26. Samples of wax submitted through H. M. Eastern African Dependencies Office were valued per cwt. landed in Europe in January at £92 10s. for the product of native hives and £97 10s. for that of the new two-chambered hive.

27. Assistance was given in four instances on request for the removal of bees nesting in undesirable places.

28. For experimental crossing with the local wild bees with a view to producing a less-fierce strain of worker three Italian queens were obtained by air from England and successfully introduced into hives of the local strain. During December two species of parasitic flies (one a Conopid, and the second, a Tachinid, *Rondanioestrus apivorus*, Vill.) caused the death of such a large number of the hybrid workers that two of the three hives were reduced almost beyond recovery. A hive of the local strain was found also to be parasitised, but only by the Tachinid and to a much less serious extent.

Miscellaneous.

29. The English and Luganda versions of the Departmental Circular on Bee-keeping for Natives have been revised and reprinted.

30. An article on entomology was written for inclusion in the proposed new edition of the Uganda Handbook.

31. A paper summarising recent work on coffee pests in Uganda was written and read at the Annual Conference of the Uganda Planters' Association.

32. Drawings and photographs have been prepared of *Helopeltis* and *Dysdercus* and their damage to cotton for the making of coloured plates for instruction and guidance of natives (and others) in the control of these pests. The Empire Cotton Growing Corporation has kindly undertaken to defray the costs of production of these illustrations to the extent of £100. Mrs. J. F. Shillito, of Nyakasura School, very kindly assisted, making two water-colour drawings of the difficult subjects, a cotton plant and leaf-damage by *Helopeltis*. The other coloured drawings were made by the native artist.

33. The list of insect pests of economic and decorative plants in Uganda was revised and distributed to the Agricultural Departments of Kenya, Tanganyika and Zanzibar for their information, and for the purpose of producing a combined pest-list for the East African Territories.

34. The Government Entomologist attended the meetings of the Annual Conference of the Uganda Planters' Association. He also prepared a report for, and attended the meeting of the Plant Pests Board in June.

Plant Imports.

35. The total number of packages of imported plants examined during the year was 207—a considerable increase over previous years.

Acknowledgments.

36. As in previous years the Imperial Institute of Entomology has afforded valuable assistance in various ways.

37. The Medical Entomologist, Kenya, kindly afforded facilities for the training of the Native Agricultural Assistant and to Native Collectors on Muboko Isle for field work on tsetse flies. The Director of the Human Trypanosomiasis Institute afforded similar assistance in the training of Native Collectors for collecting tsetse puparia.

38. Mr. W. J. Eggeling of the Forestry Department, and Mr. H. B. Johnston, Chief Locust Investigator, contributed numerous specimens for the collection.

39. During their visits to Uganda for the purpose of studying cotton pests, Mr. H. D. Nangpal, Research Assistant of the Agricultural College at Cawnpore, and Mr. H. J. Bredo, Entomologist in the Belgian Congo, both rendered valuable assistance in the survey for pink bollworm. Their visits enabled various problems of mutual interest to be discussed.

40. Dr. H. C. James, Entomologist, Kenya, kindly undertook the identification of mealy-bugs.

H. HARGREAVES,

Government Entomologist.

ANNUAL REPORT OF MYCOLOGIST, 1933.

I was on duty throughout the year, save for a short period of local leave in December.

Two visits were paid to Bukalasa in January and December to make observations on the behaviour of some of the new strains of cotton with respect to Blackarm Disease. Counts of this disease were made also on the experiments at Ngetta and Wanyange farms. Two short tours of the Usuku area of Teso were made in connection with groundnut and cotton diseases. A tour of the northern slopes of Elgon was made in December to inspect coffee plots and nurseries. In June I attended the Annual Planters' Conference and the Plant Pests Board meeting in Kampala.

(2) Diseases of Bulo (*Eleusine coracana*).

(*A*) "BLAST" DISEASE—*PIRICULARIA* SP.

The following observations on this disease, as on other diseases of this crop, were carried out chiefly on Serere Plantation, in collaboration with the Assistant Botanist, with the object of assisting in the work of selection of strains of this important native food crop resistant to disease.

Blast disease appeared in very severe form on some of the plots at Serere during the year. In native plots in the surrounding district the disease was very common, though not so evident on casual examination. The usual practice of the natives is to cultivate a very mixed population of this crop; little attempt at separation of the various types has been made by natives in the past, although they have names for the more distinct varieties, and are able to recognise them. In consequence their plots contain both susceptible and fairly resistant strains of the crop; the crop produced by the latter often masks the damage caused by disease on the former.

The disease is most prominent on the leaves, during the earlier part of the growing season, on which it causes rounded or lenticular spots, with a central grey to pale olive area on the lower surface. This is soon covered by a pale olive layer of conidiophores and conidia. At a later stage in the growth of the crop infection of the culms takes place, usually just inside one or more of the leaf-sheaths, and developing into an elongated spot, at first greyish, but soon turning brown to blackish brown. These spots involve most of the tissues of the culm at the point of attack, and in the case of some of the more slender types of the crop, the culms often collapse and fall over. Other varieties are able to remain upright.

Much of the infection on the culms takes place two or three inches below the head of grain, and completely cuts off the food supply of the head, which in consequence dries out above the site of attack. In other cases infection takes place near the base of one or more of the "fingers" of the head of grain, and such fingers do not develop further, while the rest of the head may develop in a normal manner.

This cereal is extremely susceptible to the effect of poor soil conditions, and this effect is accentuated by the attack of "blast", which is often more severe on such patches of soil. Attacked plants under these conditions remain stunted and usually produce little or no grain. Their outer leaves show the presence of the fungus in dry leaf spots, which often extend right across the lower part of the leaves and sheaths, causing the distal parts to dry out earlier than normal. The very closely allied fungus *P. oryzae* is known to act as a root parasite of rice in Japan, and it is possible that the same form of disease occurs in the present instance.

The disease has been noticed in Uganda quite recently, and earlier records are somewhat doubtful. In consequence the relation of the disease to climatic conditions is doubtful. The present heavy infection occurred in a season of few heavy rainstorms separated by periods of 10 to 14 days of hot dry weather. The earlier part of the season was drier than normal.

The fungus is carried over from season to season as conidia on the outside of the seed. Internal seed infection is known in the case of the rice fungus, and may occur on *Eleusine*. Under Uganda conditions seed treatment with fungicidal dusts is out of the question as being too expensive, and in consequence attention has to be concentrated on the selection of the most resistant strains it is possible to obtain. From observations made during the season it appears that such strains do exist in the crop as cultivated here, though the isolation and propagation of these may prove a long process.

The same disease occurs on a number of the smaller native grasses in Uganda, especially on a species of *Digitaria* which is the most common weed in plots of *Eleusine*. This grass is very susceptible to the leaf form of the disease, though the stem and head forms have not been noticed to occur on it. The grass is sown mixed with the bulo seed, as the natives have no means of cleaning their grain, and as the *Digitaria* grows very rapidly, it acts as a source of infection to the bulo.

(*B*) OTHER DISEASES OF ELEUSINE.

Gibberella Saubinettii was found attacking the base of a number of plants; the disease usually occurring in patches especially on poor soil.

Helminthosporium leucostylum, recorded in previous years as attacking the crop, was not much in evidence during the past year, occurring chiefly as a mould on dead and dying leaf and culm tissues.

A second species of *Helminthosporium* at present unidentified was associated with the death of "fingers" of grain, though the attack was of minor importance as compared with that of *Piricularia*.

(3) Diseases of Groundnuts.

(*A*) ROSETTE DISEASE.

On the whole the incidence of this disease at Serere, and on experimental plots at Katakwi and Toroma, was much less than in the previous season. The general conclusions contained in the report of the Senior Agricultural Officer for 1932 appeared to hold good for the 1933 season.

Some of the strains of this crop grown in the selection plot of the Assistant Botanist at Serere showed considerably less rosette disease than others, but we have no evidence as yet of the extent to which this resistance is inherited or to what extent we may increase it by selection.

(*B*) WILT DISEASES.

During 1933 three fungi were found attacking groundnuts and causing a wilt disease. The symptoms were very similar; at first affected plants show a few leaves wilted and inrolled, often only on one or two branches of the plant. These leaves do not recover their turgidity at night nor on a moist day, and rapidly turn first bright yellow and then brownish at the edges. Within four or five days all the leaves of the plant have more or less withered and many fallen off. The plant rapidly dries up and is quickly destroyed by termites. Any seed already formed by such plants ,if sufficiently mature, germinates *in situ*, so that later in the season the sites of wilted plants are marked by groups of young seedlings. These diseases are associated with a small ant, which bores through the wall of the fruit and also attacks the roots and stems. This ant is considered by the natives, to whom it is well known, as the cause of the trouble. Its attack is not limited to plants suffering from disease, as it frequently attacks quite healthy plants.

The three fungi found attacking groundnuts and causing wilt are *Sclerotium Rolfsii*, *Rhizoctonia bataticola* and *Fusarium* sp.

S. Rolfsii attacks the plants by way of the stem and branch tissues just at soil level. Affected parts are covered with a white mycelium, more profuse under very damp conditions, and the underlying tissues are collapsed and somewhat browned. At a later stage the fungus develops white to buff sclerotia on the parts attacked, and under very moist conditions these may extend an inch or more over the surface of the soil.

Rhizoctonia attack is distinct from the above in that the fungus forms minute black sclerotia in large numbers in the tissues of the host, imparting a greyish appearance to the tissues.

Diagnosis of the *Fusarium* form of the disease is possible only in the laboratory.

The question of the carry-over of these diseases from season to season is being investigated.

(*C*) "TIKKA" DISEASE—*CERCOSPORA PERSONATA*.

On varieties of groundnuts grown by natives in Teso during 1933 this disease was of little importance. Very few plants were free from attack, but the native types of this crop do not as a rule suffer the very severe defoliation described in other parts of the world. Here the attack is usually limited to a few small leaf-spots, often every leaflet showing infection. Certain types of groundnuts, selected in previous seasons and grown at Serere during 1933, showed the defoliation described on the older varieties of groundnuts grown in India. These strains of groundnuts had been isolated from the native crop, which therefore cannot be considered wholly resistant to this form of the disease; such types have been completely discarded at Serere as soon as they appear.

The reaction of such susceptible types to the disease is a physiological one, as often they show no more, and sometimes less severe, leaf infection by the fungus than other varieties which are still able to carry their foliage. No strain of groundnuts has been observed to be free from infection at Serere.

(*D*) LEAF-SPOT—*CERCOSPORA ARACHIDIS*.

A second leaf-spot disease of groundnuts was observed at Serere during 1933, causing larger and more diffuse spots than *C. personata*, and easily distinguished from the latter by the absence of brownish black aggregations of conidiophores on the surface of the spots, which in *C. personata* are easily visible to the naked eye. On varieties grown at Serere the spot due to *C. arachidis* is of little importance.

(4) Cotton Diseases.

(*A*) BLACKARM DISEASE.

Work on this disease occupied most of my time from May onwards to the end of the cotton season. The results of the experimental work carried out are given in the Appendix to this report.

The disease was present in Usuku and Napak counties of Teso in the early part of the season, and was partly responsible for the poor stands obtained in native plots, though adverse weather conditions were the chief cause. By August many of the plants had recovered from the attack of the disease, especially in the southern part of the area in question. Around Katakwi the disease was still active in August, and a considerable amount of shedding of bolls $\frac{1}{2}''$ to $\frac{3}{4}''$ in diameter was taking place as the result of infection by the disease. On such bolls infection had taken place originally on the green bracts, whence it had spread into the stem at the base of the bolls and often through this into the branch below. During August and September showery weather was experienced in this area and further boll shedding and branch infection took place.

Inspection of the Experiment Farms at Wanyange, near Jinja, and Bukalasa, in December, indicated that this disease may be in process of becoming more important in South Busoga and Buganda. Infection was considerably above expectation, and may have been due to the favourable effects of climatic conditions on spread of the disease during the growing season, or alternatively to gradual accumulation of infection on the seed supply of these areas.

The development of more resistant varieties of cotton has been engaging the attention of the Botanical Section of the Department for some years, and assistance was given them in the classification of their new strains of cotton with regard to disease resistance. At Serere it has been found that to some extent high resistance is associated with low yielding capacity, so that the problem of selection of suitable varieties for the future is thereby complicated. This association may be more apparent than real, as slow growing plants on poor soil appear to be more resistant to infection than plants making more normal growth, though when such poor plants once become infected they are liable to suffer more severely than normal plants, and may even die out completely.

(*B*) WILT DISEASE.

Observations made by the Senior Botanist indicate that this disease is increasing in incidence in parts of Buganda. Whereas a few years ago only odd cases were noticed in native plots the disease appeared during 1933 in quite a number of native plots around Bukalasa, and the incidence in each plot was markedly greater. Reports of what appears to be the same disease were received for the first time from Bugishu and Bugwere. It was also recorded for the first time at Serere Experimental Station, on two lines of cotton grown from seed forwarded from Bukalasa. The last instance appears to indicate the possibility of transmission of the disease either on or in the seed.

Examination of affected plants shows yellow to brown streaks in the woody tissues of the roots and base of the stem, frequently originating from a single lateral root. The tissues contain hyphae and microconidia of a *Fusarium*, probably *F. vasinfectum*. Above ground the plants show a sudden wilting and rolling of the leaves, which are shed a few days later, leaving the plants more or less bare. Death of the plants often follows very rapidly.

Under Uganda conditions control of a disease of this type must be limited to the isolation of strains of cotton resistant to infection. Experience in other countries indicates that infection remains in the soil indefinitely, and in consequence a gradual accumulation of soil infection may be expected in the future in Uganda. Hitherto cases have been more or less sporadic in native plots, but when in the course of native practice of rotation, these same plots are again planted with cotton, the disease may be expected to occur in larger patches. Unfortunately the majority of cases have occurred in districts comparatively densely populated, so that the period of rotation is shorter than in other areas, with the result that a disease of this type will probably increase more rapidly, and be more difficult to deal with.

For the selection of strains of cotton resistant to this disease it is necessary to have heavily infected land available, to ensure that all plants grown on it come into contact with the disease organism. A draft programme for inoculation of a plot of land with the fungus, and for the isolation of wilt-resistant cotton, was drawn up in consultation with the Senior Botanist during the year.

(*C*) OTHER COTTON DISEASES.

No reports of cotton diseases other than those mentioned above, were received during the year. Internal Boll diseases were less prevalent in Teso during 1933 season than for some years previously, being associated with a comparative dearth of *Dysdercus*. The proportion of stained cotton in the crop of this district as bought at the various markets and ginneries was much smaller than usual.

(5) Diseases of other Crops.

Cassava Mosaic.—This disease was found to be almost universal on native cassava in the Usuku area of Teso in August. Some evidence of its spread from plant to plant during 1933 in this area was obtained, whereas experience in the past in Buganda has indicated that such spread is comparatively rare in that part of Uganda. Selection of uninfected material for planting is the only means of practical control.

Black Shank Disease of Tobacco, caused by *Pythium* sp., occurred in a plot of imported varieties grown at Serere, but its incidence was unimportant.

Bean Mosaic.—A serious mosaic disease of *Phaseolus* sp., was found in some of the Serere plots. Affected plants were stunted and the leaves very much wrinkled and curled, being slightly thicker than normal. Affected plants produced practically no crop. Soy Beans appeared to suffer from a very similar disease, but little effect was noticed on crop production in this case.

Sorghum smut (*Sphacelotheca sorghi*) was noticed in Usuku, about ten per cent. of the heads in some plots being infected. The crop is of minor importance, being used to supplement the main cereal *Eleusine*, and although control of the disease is relatively simple and cheap, it is doubtful whether control measures are warranted.

Root Disease of Tea (*Armillaria mellea*).—Further specimens were received during the year. The thorough clearing of land is the best method of avoiding trouble from this disease, taking care that all large roots and stumps of trees are removed before planting the tea.

The disease of *Dolichos lablab* reported in 1932 as due to *Sphaceloma* sp., again occurred at Serere. Plots of *Canavalia ensiformis* also showed infection. Other legumes were not affected.

C. G. HANSFORD,

Mycologist.

BLACKARM RESEARCH, 1933-34.

At Serere a single field experiment was carried out during this season, consisting of 144 plots each containing 280 holes at 3 ft. by 1 ft. spacing, arranged in six randomised blocks. The following treatments were used :—

(*a*) Each block was divided at random into four strips of six plots each ; one strip was sown on May 26th, a second on June 19th, a third on July 12th, and the remaining strip on August 12th.

(*b*) Each sowing date strip was divided at random into two sub-blocks of three plots each, one of these was sown with the standard variety, S.G. 29, and the other with S.P. 1, a derivative of the South African variety U. 4/4/2.

(*c*) The three plots of each variety sub-block were sown with seed :—
- (i) Treated with the dust "Abavit B,"
- (ii) Treated with another fungicidal dust "413a,"
- (iii) Untreated seed as a control.

The experiment was designed with the object of obtaining information on the following points :—

(*a*) The influence of date sowing on the rate of spread of the disease, both on the leaf-spot form and on stem infection.

(*b*) The influence of sowing date on yield.

(*c*) Varietal differences in susceptibility to the disease and in yield.

(*d*) The influence of seed treatment on disease and yield.

Observations made.—Frequent observations were made during the season on the stand of plants in each plot, the number of plants infected with Angular Leaf Spot and with Blackarm, also those infested by the insect *Helopeltis*.

Results.

A. GERMINATION.

Treatment Means.—

Variety S.G. 29.

	Control.	Abavit B.	413a.	Mean.
May	237·5	73·8	247·2	186·2
June	234·5	256·2	273·5	254·7
July	195·2	194·8	199·3	196·4
August	159·8	146·7	152·2	152·9
VARIETY MEAN ...	206·8	167·9	218·9	197·6

Variety S.P. 1.

May	182·2	165·2	181·2	176·2
June	215·7	255·7	255·0	242·1
July	188·7	170·7	199·7	186·3
August	133·9	130·0	139·2	134·3
VARIETY MEAN	180·1	180·4	193·8	184·8

Conclusions.—The effect of weather conditions during the germination period is very significant, as would be expected. The June sowings experienced moister conditions than the other sowings.

S.G. 29 shows a consistently higher germination than S.P. 1 in this experiment, the difference being highly significant. The interaction Variety × Sowing Date is not significant.

The effect of seed treatment is very significant, the dust 413a being best, while Abavit B gave lower germination than the controls, especially in the June sowings. The dust 413a increased germination by 6·5% over the controls, averaged over all.

The interaction of Seed Treatment × Sowing Date is significant, the relative increase in germination being increased under the moist conditions of June. The low germination of the May sown seed treated with Abavit B is unexplained, unless due to an overdose of the dust, which is a mercurial compound.

B. PRIMARY INFECTION.

The infection was counted on the seedlings one month after sowing, and is expressed below as a percentage of the total seedlings per plot.

Treatment Means:—

Variety S.G. 29.

Sowing Date.	Control.	Abavit B.	413a.	Mean.
May	65·5	0·8	3·8	22·8
June	22·5	1·2	0·8	8·2
July	11·5	0·8	1·0	4·4
August	5·0	1·8	1·8	2·9
VARIETY MEANS ...	26·1	1·2	1·9	9·7

Variety S.P. 1.

May	6·2	0·0	0·0	2·1
June	0·8	0·3	0·2	0·4
July	3·7	0·5	1·0	1·7
August	3·2	1·2	1·7	2·0
VARIETY MEANS ...	3·5	0·5	0·7	1·6

Analysis of Variance of the counts indicates that the following are very significant (P much less than 0·01) :—

Variety.—S.G. 29 shows much heavier infection than S.P. 1.

Sowing Date.—May is significantly the worst, and June shows more infection than August; the difference between July and August is not significant. As the seed was as uniform as it was possible to obtain, the differences between the sowing dates may be due either to a gradual dying out of the bacteria on the surface of the seed, or to soil conditions during germination. In respect to the latter, the conditions were moist at the time of the June sowings, whereas the May sowings show a much heavier infection.

Seed Treatment.—Both compounds used in treating the seed reduced the amount of of infection to a significant extent.

Variety × *Sowing Date*—S.G. 29 showed very heavy infection in May.

Treatment × *Sowing Date.*—The May controls showed relatively heavier infection in May than in subsequent months.

Treatment × *Variety.*—The infection in the dusted plots of S.P. 1 was higher than expectation, while that in the corresponding plots of S.G. 29 was lower than expectation.

Treatment × *Variety* × *Sowing Date.*—The S.G. 29 controls in the May sowings were very heavily infected.

C. SECONDARY LEAF INFECTION.

Frequent counts were made during the season of the infection in each plot. Analysis of these counts shows that the effect of Sowing Dates became less and less as the season progressed, and by September 21st the differences between these were no longer significant at P. 0·05. By October, the interactions Variety × Sowing Date and Treatment × Sowing Date had passed below this level of significance. This process was due to the rapid rise in infection on the later sowings, while the May sowings of S.G. 29 were completely infected, and those of S.P. 1 showed slower increase of the disease.

In order to obtain comparative figures of the infection on the various plots the total infection days per plot were estimated as follows :

$$\frac{\Sigma\ (\%\ \text{plants infected} \times \text{No. of days infected}) \times 100}{\text{No. of days since planting.}}$$

The resulting figures obtained for each plot of the experiment give the average infection in that plot as a percentage of the growth period of the plants in that plot; the summation was extended to October 31st, after which date observations were confined to the stem form of the disease.

PERCENTAGE INFECTION DAYS.

Variety S.G. 29.

Sowing Date.	Control.	Abavit B.	413a.	Mean.
May	84·3	52·5	54·9	63·9
June	66·3	46·9	45·6	52·9
July	63·1	44·8	46·8	51·5
August	49·3	38·6	42·5	43·4
VARIETY MEANS ...	65·8	45·7	47·4	53·0

Variety S.P. 1.

May	34·9	8·4	7·6	17·0
June	26·6	10·9	14·4	17·3
July	34·0	17·6	17·8	23·1
August	31·6	20·1	24·5	25·4
VARIETY MEANS ...	31·8	14·2	16·1	20·7

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	Sum of Squares.	Variance.	z.	P.
Total (a)	23	6,249·60	...	...	...
Blocks	5	1,756·73	351·35	...	...
Sowing Dates	3	800·60	266·87	...	...
Error (a)	15	3,692·27	246·15	...	...
Total (b)	47	49,056·92	...	...	...
Total (a)	23	6,249·60	...	...	...
Variety	1	37,484·19	37,484·19	3·16312	0·01
Variety × Sowing Date ...	3	3,982·20	1,327·40	1·49272	0·01
Error (b)	20	1,340·93	67·05	...	...
Total	143	63,802·99	...	...	...
Total (b)	47	49,056·92	...	...	...
Treatments	2	10,349·98	5,175·00	2·53580	0·01
Treatment × Variety ...	2	53·77	26·88	...	...
Treatment × Sowing Dates ...	6	1,635·11	272·52	1·06385	0·01
Treatment × Variety × Sowing Dates	6	110·75	18·46	...	...
Error (c)	80	2,596·46	32·46	...	...

CONCLUSIONS.—

Sowing Dates.—The differences between these are not significant.

Varieties.—S.P. 1 shows much less infection than S.G. 29.

Treatments.—Dusting the seed with the compounds used in this experiment has reduced infection to a significant amount.

Variety × Sowing Date.—This interaction is very significant, chiefly in that the disease spread more rapidly on S.P. 1 in the July and August sowings than in the earlier sowings. This indicates that under weather conditions very favourable to the spread of the disease the resistance of this variety to infection can be modified, though it always remains more resistant than S.G. 29.

Treatment × Sowing Date.—The effect of seed treatment was relatively greater in the earlier sowings, in that the spread of the disease was retarded for a longer period. The average reduction of infection in the May sowings amounted to 42 days per plant, in the June sowings 23 days per plant, 19 days in the July sowings and only 7 days in the August sowings.

The other interactions were not significant.

D. STEM INFECTION.

The following figures show the Percentage Infection Days over the experiment, calculated in the same manner as described above for Leaf Infection Days, but the summation extended to December 1 :—

Variety S.G. 29.

Sowing Date.	Control.	Abavit B.	413a.	Mean.
May	74·0	60·1	62·7	65·6
June	73·5	63·3	64·6	67·1
July	67·4	52·2	53·9	57·8
August	50·8	43·6	47·2	43·9
VARIETY MEANS ...	66·4	54·8	54·6	58·6

Variety S.P. 1.

May	39·8	37·4	35·1	37·5
June	29·0	29·4	26·3	28·2
July	27·4	24·9	25·8	26·0
August	26·7	20·7	20·8	22·4
VARIETY MEANS ...	30·7	28·1	27·0	28·0
TREATMENT MEANS ...	48·6	41·4	40·8	43·6

Analysis of Variance gives the following results :—

Sowing Dates.—Significant at P. 0·01 ; May and June show no significant difference, both are greater than July, and July in turn shows significantly more infection than August.

Variety.—Significant at P. 0·01 ; S.G. 29 shows more disease than S.P. 1.

Treatment.—Significant at P. 0·01 ; the dusted seed gave less infection than the controls, there being no real difference between the two dusts.

Variety × *Sowing Date*—Significant at P. 0·01 ; S.G. 29 shows higher infection in proportion to S.P. 1 in the June and July Sowing Dates than in May and August.

Treatment × *Variety.*—Significant at P. 0·01 ; the dusts have more effect in reduction of infection on the susceptible variety S.G. 29 than on the more resistant S.P. 1.

The other interactions are not significant at either P. 0·01 or P. 0·05.

E. INFESTATION BY HELOPELTIS.

During the season a considerable number of the plants were attacked by this insect, and a count was made of the number of plants attacked in each plot. Analysis of this count showed that the position of plots in the experiment was significant, and that S.P. 1 showed significantly less attack than S.G. 29, 40·3% as against 51·8%. The seed treatments were also significant at P. 0·01, the controls showing 49·1%, Abavit B plots 44·8%, and the 413a plots 44·3%.

F. FINAL STAND.

Analysis of the count made over the whole experiment gives the following results :—

Sowing Dates.—Significant at P. 0·01 ; June and July sowings had significantly better stands than August, which was in turn significantly better than May.

Varieties.—Difference not significant.

Treatments.—Significant at P. 0·01, the control plots averaged 240 plants per plot, the Abavit B plots the same, while the 413a plots were significantly better with an average of 255 plants.

Variety × *Sowing Date.*—Not significant.

The other interactions, Treatment × Variety, Treatment × Sowing Date, and the third order interaction were all significant, chiefly due to the abnormal effect of Abavit B on the germination of the May sowings of S.G. 29, mentioned in the analysis of germination above, and which persisted throughout the season on those plots.

G. TOTAL YIELD.

The following treatment means have been converted into lbs. of seed cotton per acre :—

Variety S.G. 29 :—

Sowing Date.	Control.	Abavit B.	413a.	Mean.
May	298·4	244·1	363·3	301·9
June	280·4	351·4	331·7	321·2
July	257·6	271·8	283·7	271·0
August	245·2	288·7	302·0	278·7
VARIETY MEANS ...	270·4	289·0	320·2	293·2

Variety S.P. 1 :—

May	562·0	547·7	627·4	579·1
June	578·1	593·7	581·6	584·4
July	513·0	531·4	463·9	502·8
August	382·6	412·4	411·3	402·2
VARIETY MEANS ...	508·9	521·3	521·1	517·1
TREATMENT MEANS ..	389·7	405·2	420·6	405·1

Analysis of the actual yield figures is as follows :—

	Degrees of Freedom.	Sum of Squares.	Variance.	z.	P.
Total (a)	23	484·7522			
Blocks	5	303·9730	60·7946	1·2624	0·01
Sowing Dates	3	107·7599	35·9200	0·9993	0·01
Error (a)	15	73·0193	4·8680		
Total (b)	47	1,302·9748			
,, (a)	23	484·7522			
Varieties	1	671·2417	671·2417	2·4573	0·01
Varieties × Sowing Dates ...	3	48·6028	16·2009	0·5960	0·05
Error (b)	20	98·3781	4·9189		
Total (c)	143	1,441·7282			
Total (b)	47	1,302·9748			
Treatments	2	8·5562	4·2781	0·6299	0·05
Treatments × Varieties ...	2	3·6404	1·8202	0·1926	...
Treatments × Sowing Dates	6	24·9864	4·1646	0·6165	0·05
Treatments × Varieties × Sowing Dates ...	6	4·4638	0·7440		
Error (c)	80	97·1066	1·2138		

CONCLUSIONS :—

Sowing Dates.—The least significant difference is 55 lbs. per acre ; therefore the yield from the May and June sowings is very significantly more than that from the August sowings ; the differences May—July and July—August are slightly below the level of significance.

Varieties.—S.P. 1 is a much heavier yielder than S.G. 29.

Treatments.—The least significant difference is 23·8 lbs. per acre ; thus the seed dusted with 413a has yielded significantly better than the control untreated seed.

Variety × Sowing Dates.—The difference between the two varieties is less in the August sowings than in the earlier sowings.

Treatment × Sowing Dates.—Mostly due to the abnormal effect of Abavit B on the May sowings of S.G. 29.

H. YIELD OF CLEAN COTTON.

TREATMENT MEANS CONVERTED TO LBS. PER ACRE.

Variety S.G. 29:—

Sowing Date.	Control.	Abavit B.	413a.	Mean.
May	178·8	158·8	204·6	180·7
June	199·7	263·7	229·7	231·0
July	182·9	192·5	191·4	188·9
August	186·1	216·8	238·6	213·9
VARIETY MEANS	186·9	207·9	216·1	203·6
Variety S.P. 1:—				
May	343·0	317·4	390·3	350·2
June	400·3	420·0	398·1	406·1
July	364·1	375·8	307·1	349·0
August	299·8	318·9	316·1	311·6
VARIETY MEANS	351·8	358·0	352·9	354·2
TREATMENT MEANS	269·4	283·0	284·5	278·9

Analysis of the yields gives the following as significant :—

Varieties.—(P. 0·01). S.P. 1 gives a better yield than S.G. 29.

Treatment × *Sowing Date.*—The yield from the May sowings treated with Abavit B is low ; also that from the July sowings treated with 413a.

Sowing Dates.—(P. 0·05). The June sowings gave significantly more clean cotton than the other sowings, between which there was no significant difference in yield.

J. INFLUENCE OF STAND ON YIELD.

ANALYSIS OF CO-VARIANCE STAND × YIELD.

	Degrees of Freedom.	Product Sum.	Co-Variance.
Total (a)	23	+781·4743	
Sowing Dates	3	+57·2757	+19·0919
Blocks	5	+677·2460	+135·4592
Error (a)	15	+46·9526	+3·1302
Total (b)	47	+871·0693	
Total (a)	23	+781·4743	
Varieties	1	−553·4813	−553·4813
Varieties × Sowing Dates	3	+236·8716	+78·9572
Error	40	+406·2047	+20·3102
Total (c)	143	+1,821·0993	
Total (b)	47	+871·0693	
Treatments	2	+225·8978	+112·9489
Treatments × Sowing Dates	6	+590·7966	+98·4661
Treatments × Varieties	2	+14·6191	+7·3096
Treatments × Varieties × Sowing Dates ...	6	+107·6915	+17·9486
Error (c)	80	+11·0250	+0·1378

The value of "b" in the regression equation :

$$\text{Yield} = k + b.\ (\text{Stand})$$

works out at +0·0013917

Correcting the values of the treatment yields (total yield) for this linear regression we obtain the following for totals :—

Control	... ...	344·66 lbs. total.
Abavit B	... ...	358·97 „ „
413a	... ...	372·76 „ „

The value of the Least Significant Difference between these totals works out at 22·01 lbs.; so that, after correcting for the effect of differences in stand on yield we obtain the same conclusion as before, namely, that the yield from the 413a treatment is significantly better than that from the controls.

K. EFFECT OF SEED TREATMENT ON S.G. 29.

Examination of the yield figures (total yield) given under paragraph *G* above, shows that whereas S.G. 29 averaged 293 lbs. per acre, S.P. 1 averaged 405 lbs. In view of the great difference in yield between these two varieties it was considered advisable to analyse the figures for each separately, as the lay-out of the experiment consisted of 24 variety sub-blocks inside which the three seed treatments occurred at random.

ANALYSIS OF VARIANCE OF TOTAL YIELD OF S.G. 29.

	Degrees of Freedom.	Sum of Squares.	Variance.	z.	P.
Total (a)	23	115·7506			
Blocks	5	69·5627	13·9125	0·7220	0·05
Sowing Dates	3	10·4525	3·4842	0·0799	
Error	15	35·7354	2·9696		
Total (b)	71	187·1791			
Total (a)	23	115·7506			
Treatments	2	11·3032	5·6516	0·8089	0·05
Treatments × Sowing Dates	6	15·2921	2·5487	0·4108	
Error	40	44·8332	1·1208		

The Least Significant Difference between the treatment means given in paragraph *G* above is 31·4 lbs. per acre. Thus the plots from seed treated with the dust 413a gave a significantly higher yield than the controls, while the difference between the former and those treated with Abavit B is just short of the level of significance.

L. EFFECT OF TREATMENT ON S.P. 1.

Analysis of the yield of this variety gives only Sowing Dates as showing significant differences; May and June are both significantly better than August.

M. EFFECT OF SPACING ON S.G. 29.

In order to determine the spacing which gives maximum yield it is necessary to fit a curved regression line to the data of the experiment. The simplest is :

$$\text{Yield} = k \text{ (constant)} + b \text{ (area per plant)} + c \text{ (area per plant) } 2.$$

To fit this curve the following analyses were made :

(*A = area per plant*).	*Value Found.*
Variance of A	0·3591
Variance of A^2	33·59524446
Co-variance Y × A	+0·8999
Co-variance Y × A^2	+2·096767
Co-variance A × A^2	+3·348758

In each case these figures represent the error variance or co-variance of the variety sub-blocks.

The resulting equation is :

$$Y = -56{\cdot}0973 + 27{\cdot}3109\ A - 2{\cdot}6599\ A^2.$$

The maximum of this equation occurs at A = 5·134 sq. ft., corresponding to a spacing of 3 ft. by $20\frac{1}{2}$ ins.

N. EFFECT OF SPACING ON S.P. 1.

Calculated in a similar manner to the above the regression equation for this variety is :

$$Y = +0{\cdot}0914 + 4{\cdot}7118\ A - 0{\cdot}5331\ A^2.$$

and the maximum occurs at A = 4·419 sq. ft., corresponding to a spacing of 3 ft. by $17\frac{1}{2}$ ins.

O. EFFECT OF SEED TREATMENT ON S.G. 29, CORRECTING YIELD FOR STAND EFFECT.

Using the variances and co-variances of the residual error of the 72 plots of this variety the regression equation becomes :

$$Y = -44{\cdot}75 + 23{\cdot}3890\ A - 2{\cdot}4792\ A^2.$$

The total yields for the three treatments become :

Control	113·64 lbs.	Least Significant Difference 22·16 lbs.
Abavit B	130·54 „	
413a	163·86 „	

Thus when the effect of differences in stand or plant number are eliminated the treatment of the seed with the dust 413a still remains significant over the controls in total yield.

P. EXPERIMENTS AT OTHER CENTRES.

As a check on the results obtained at Serere duplicate experiments were carried out at Ngetta and Wanyange Farms. At each centre the experiment consisted of four randomised blocks of six plots each, divided at random into variety sub-blocks of three plots each; the two varieties of cotton S.G. 29 and S.P. 1 were used for these experiments and the same seed treatments as in the Serere experiment.

RESULTS.—

Ngetta.—S.G. 29 gave a better stand of plants than S.P. 1.

The dust 413a gave a better stand than Abavit B, which in turn was better than the controls from untreated seed.

S.P. 1 gave significantly higher yield than S.G. 29; but the effect of seed treatment was not significant, though both dusts gave an increase in yield.

When the effect of differences in stand was eliminated the differences in yield due to seed treatments still remained below the level of significance.

Dusting the seed reduced infection by Blackarm disease to a significant extent.

Wanyange.—No significant differences in stand or yield were obtained from this experiment; S.P. 1 was much more resistant to disease than S.G. 29. This experiment was planted on new land, and the plants grew very large and woody, the yield being very poor.

Summary of Results.

In general the results obtained from these experiments are in agreement with those obtained in previous seasons.

Disinfection of cotton seed prior to planting, by means of fungicidal dusts, increases germination and reduces the amount of Angular Leaf Spot and Blackarm in the crop. As a result of these effects with the dusts used there are strong indications of a gain in crop. In the Serere experiment on S.G. 29 the gain in yield from treating the seed with the dust 413a amounted to 16% over the untreated seed.

In general the earlier sowings yield better than the later and the effect of seed treatment on infection by disease is greater in the earlier sowings. In the Serere experiment both Angular Leaf Spot and Blackarm spread much more rapidly in the later sowings than in the plots sown in May and June. This is probably a seasonal effect, as the later sowings have less time for growth before the onset of the rainy season in late August and September, during which infection spreads much more rapidly than earlier in the season.

Throughout these experiments the difference in disease resistance between S.G. 29, the present standard variety, and S.P. 1, a selection from U. 4/4/2, has been most outstanding. Both forms of disease spread much more rapidly on the former variety, and observations in the field indicate that S.G. 29 is less able to throw off the disease and make complete recovery from the stem form than is S.P. 1. The stem lesions on S.G. 29 are often much more extensive than on S.P. 1, and remain in an active state for longer periods. The figures given above for "Stem Infection Days" do not give a real indication of the relative resistance of the two varieties, as every plant showing a single infection on the stem or branches was included as infected in the counts made, no attempt being made to weight this variate for the extent of infection on individual plants.

ANNUAL REPORT OF THE AGRICULTURAL CHEMIST FOR THE YEAR 1933.

General and Advisory.

No survey of the year's field work would be complete without reference to the extension of the practices of mulching and manuring with cotton seed. All the field trials to date have pointed to the fact that organic manures pay better than artificials, taking into account the fact that the organic materials are obtained locally whilst artificials have to pay sea, rail and road transport charges. The field experiments are being continued as indicated in a later section of this report, but already planters are turning their attention to local materials rather than to expensive imported artificials.

Mulching is now the rule on all coffee land both native and non-native where grass or other material is readily available. On the other hand, where any sort of transport charges have to be met its economic value has yet to be proved, particularly in view of the low prices now ruling for the crop. On permanent crops such as coffee or tea the effect of the mulch is easily seen within a few weeks of application, the leaves are darker and the whole appearance of the tree is more healthy than on unmulched areas. In calculating the cost of a mulch it must be realised that weeding and cultivation costs must be deducted from the gross cost because, under a mulch, cultivation and weeding are not necessary. As an anti-erosion measure the value of a mulch cannot be over-emphasised. Already, areas which would have been abandoned through erosion have been brought back to a paying crop by mulching. It must be remembered that, in addition to the conservation of moisture and the prevention of erosion, the application of a mulch means the addition of both organic and inorganic plant-food.

The use of cotton seed as a manure has also increased, as much as 600 tons having been used on one estate. Experiments on the effect of the oil content of cotton seed on its value as a fertiliser have been started. Work in India has shown that cotton seed meal is more rapid in its action than whole seed. The only records available are to the effect that the oil merely retards the action. In a country of heavy rainfall this would appear to be an advantage in that there is less danger of leaching of nitrates. There is no record of the accumulation of vegetable oils in the soil to the detriment of the plant or of the soil micro-organisms. In preliminary tests here a complete rot of whole cotton seed has been obtained in three months provided that the seed was rotted in a pit and liberal watering given progressively as the pit was filled. An even quicker rotting has been obtained when the seed was mixed with soil in trenches, between the coffee lines, early in the rains. Very little oil remained in either case which indicates that there must be organisms present in the seed or soil capable of breaking down the vegetable oil. The direct application of the seed in trenches to a permanent crop is less costly than previous pit-rotting, the one essential being plenty of rain to assist decomposition. The germination which occurs under these conditions is not important because the seedlings can easily be dug in. The effect of the cotton seed applied in this way is very noticeable within a few months and it has been observed that the roots of the trees grow towards the decomposing material. The pit-rotting is demonstrably wasteful in nitrogen because a strong smell of ammonia is always present when the pits are opened up. Work on the effect of the oil content of the seed on nitrification is being continued.

Laboratory.

The following is a summary of the work carried out in the laboratory during the year.

SOILS:—	
Mechanical analyses	237
Replaceable bases	90
Nitrogen total and nitrate	227
Moisture at the point of stickiness	60
Reaction	83
Clay fractions	6
MISCELLANEOUS:—	
Essential oils	7
Groundnut oil content	14
Shea butter oil content	8
Oil-cakes	3
Waters	3
Fertilisers	1
Sludge and scale	2

Soils.

The analysis of clay fractions, except for special purposes, have now been discontinued in this laboratory. Mr. G. Milne, Soil Chemist, East African Agricultural Research Station, Amani, has undertaken to carry out analyses of the clay fractions of such profiles as may be deemed representative of major soil-types; for example, clay fractions of the Bukalasa catena have been sent to him and these will be followed in due course by samples from other soils representative of different districts. This has relieved us of a very considerable amount of analytical work and has enabled progress to made with chemical aspects of more immediate interest.

Attention has been devoted particularly to the determination of readily soluble potassium, calcium, and phosphorus; even at this stage it may be prophesied that information of great practical value will be obtained.

Those soils which have been examined have a much higher base-status than could have been suspected from what is surmised of their history. One would think that with the high rainfall our soils would be correspondingly highly leached but in point of fact the calcium and potash contents of those soils which have been examined compare favourably with those of agricultural soils in temperate climates. Values for exchangeable calcium (soluble in semi-normal acetic acid) range up to 0·6 per cent., and for potash up to 0·07 per cent. There are striking local variations, however, and it is to be expected, particularly on undulating land, that a soil well stocked with soluble bases may lie within a few yards of a comparatively impoverished section. These local variations excepted, it does not seem probable that potassium deficiency is likely to prove an obstacle in the development of agriculture in Uganda.

Phosphate on the other hand may prove to be a limiting factor in crop production. Judging by the comparatively few determinations which have been made it appears that the content of readily soluble phosphate may be low, compared with figures for agricultural soils of temperate climates. It remains to be seen whether these low values do actually indicate phosphatic deficiency, or whether the phosphate, present in combination, becomes available under tropical conditions sufficiently quickly to give optimum growth. The comparatively high calcium content is interesting in view of the distribution of the muvule tree (*Chlorophora excelsa*). The fact that muvule timber often contains large stones in the heart wood has already been recorded.* Analyses of the stone and sap have shown a high calcium content, indicating that the tree needs a soil rich in calcium. A study of the soils of a typical muvule district supports this view although there was no free calcium carbonate. These studies will be of value in giving a reasonably safe field estimate of the calcium status of a soil type.

With a view to examining the prospects for an extension of tea growing in Uganda typical soils from various areas have been tested for acidity. The areas concerned were West Nile, Kigezi, Toro, Bunyoro, Masaka and Mityana. In the last-named area tea has been growing for many years and has been satisfactory both in yield and market value. The mean annual rainfall is 47″ to 48″ and the pH between 6 and 6·5. Thus the rainfall is lower and the soils less acid than the generally accepted ideal condition for this crop which calls for a well distributed rainfall of 60″ and a pH of 5·2 to 5·6.† Since the yields and quality are good, Mityana may be taken as a standard for Uganda conditions and all the areas except Kigezi, where the rainfall is only 35″ to 40″, may be said to conform to the standard. Even in Kigezi, the rainfall is well distributed; thick morning mists, seldom clearing before 10 a.m. are the rule during certain seasons, and therefore the effective rainfall is much higher. In these circumstances all the areas mentioned are worthy of trial.

In addition to the above, and in collaboration with Agricultural Officers, soil survey work is being continued as rapidly as possible and a preliminary soil map is being prepared. It is obvious that, with the staff available, the map can only be sketched in broad outline showing the major soil-types leaving the more detailed work to be carried on as time permits. The full story can only be told when the responses of the various soil-types to cultural and manurial treatments are known, and the field and laboratory studies are equally important in finally assigning boundaries on the map.

Miscellaneous.

ESSENTIAL OILS.

The position as regards an essential-oil industry for Uganda may be said to have cleared considerably during the year as a result of the valuations quoted in last year's report. The Singapore patchouli has been imported and is being increased for trial. The only other materials being propagated for more extensive trial are geranium (near mawah), lemon grass, vetivert and possibly lemon verbena. Since the last valuation of lemon grass oil was obtained its value has doubled and has been steady at 4s. 6d. per lb. for nearly a year but has since dropped to four shillings.

Later reports on *P. radula* and vetivert indicate that there would be a market for the geranium at 10s per lb. *c.i.f.*, London, and that the vetivert would fetch at least as much as the Bourbon, *i.e.*, 15s. to 20s. per lb. spot London, duty paid.

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*Annual Report, Department of Agriculture, 1929, p. 51.

†H. H. Mann, *Empire J. Expt. Agric.*, 1933, I, pp. 245—252.

GROUNDNUTS.

Thirteen samples of groundnuts from three Variety Trials in the Eastern Province were examined on behalf of the Botanical Section to determine what influence, if any, climatic and soil conditions have on the oil-content.

Variety.	Grown at	Oil %	Variety.	Grown at	Oil %
Virginia Bunch ...	Katakwe ...	43·4	Serere Bunch ...	Katakwe ...	44·7
	Toroma ...	44·9		Toroma ...	44·2
	Serere ...	41·5		Serere ...	43·3
African Bunch ...	Katakwe ...	44·2	Tanganyika Bunch ...	Toroma ...	44·2
	Toroma ...	44·7		Serere ...	44·3
	Serere ...	42·4			
Local Spreading ...	Serere ...	43·5	Serere Mass Selected...	Serere ...	43·6

It would appear that most varieties give a higher oil-content on the lighter soils of Usuku than at Serere but the differences are not such as to justify selection on the basis of oil-content. As groundnuts are bought on appearance only, this basis of selection, coupled with yield, would appear to offer more scope.

SHEA BUTTER.

In buying Shea Butter nuts for a trial shipment to England the Agricultural Officer, Teso forwarded three samples of nuts for determination of oil-content. One was a sample from the consignment to England and the others were rejected during grading.

Sample.	Description.	Oil %	Moisture %.
1.	Nuts of very good appearance	52·0	6·6
2.	Shrivelled black nuts	51·3	7·0
3.	Young white, well-filled nuts, retaining seed coat ...	55·3	6·1

The fat from the black nuts was semi-solid at 20°C whilst that from the other samples did not solidify. The young nuts gave the highest oil content but all the samples gave yields well within the range given for other countries.*

Samples from five observation trees were also examined for the Botanical Section from the point of view of seed selection.

Tree No.	Moisture % on dry matter.	Oil % on dry matter.
1	6·2	55·5
2	8·2	51·5
3	6·6	55·4
5	5·7	50·1
7	5·6	53·0

Trees 1 and 3 are much higher yielders than the others and equal to the best ever reported on at the Imperial Institute.

OIL CAKES AND MEALS.

Two samples of simsim cake and one of groundnut cake were examined for oil content as a test of the efficiency of the machinery.

	Moisture %.	*Oil %.*
Simsim cake 1	6·6 ...	24·7
Simsim cake 2	10·4 ...	22·45
Groundnut cake	9·6 ...	16·8

In each case the percentage of oil is much too high and suggestions were made to give a more efficient extraction.

*Imperial Institute Selected Reports, 1914.

Country of Origin.	*Fat %.*
Nigeria S.	41 to 54·5
Nigeria N.	48·6 to 52·4
Gold Coast	51·2
Sudan	47·2
Uganda, 1911 sample	49·9

Further samples were submitted later for report on value as feeding stuffs. The results together with some standard feeding tests (Kellner) are as under:—

	Local sample.	Kellner figures for comparison.		
			Digestible nutrients %.	Digestibility co-efficient.
Groundnut meal.—				
Moisture	9·0	9·8		
Ash	8·3	7·5		
Fat	18·1	9·2	8·3	90·0
Fibre	8·5	5·2	0·8	15·4
Protein	37·3	44·5	4·0	91·0
Carbohydrate	18·8	23·8	20·0	84·0
Simsim cake.—				
Moisture	9·2	9·5		
Ash	9·4	10·7		
Fat	16·4	12·6	11·8	93·5
Fibre	8·2	6·8	5·0	74·5
Protein	36·9	39·8	36·6	92·0
Carbohydrate	19·9	20·6	14·6	71·6

It will be seen that the fat-content is in each case much higher than the cakes used for feeding in Europe and a small-scale feeding trial on reduced ration was advised to begin with.

SIMSIM IMPURITIES.

Exporters have complained that Uganda simsim is no longer safe to handle owing to the high percentage of admixture which amounts to as much ten per cent. Five samples, as exposed for sale by natives, were collected and examined.

Sample.	Locality.	Admixture. %	Type admixture.
1	Kitgum ...	2·7	Mainly sand, with some immature seed.
2	Gulu ...	2·4	Sand, immature seed and some small seeds.
3	Kyeri ...	3·6	Immature seed.
4A	Lira ...	2·7	Mainly immature seed, a little soil.
4B	Lira ...	0·8	Immature seed.

Four of the samples fall below the three per cent. mark allowed by contract and, since the screenings of the fifth sample consisted entirely of immature simsim this sample would not be affected by the penalty clause. It is certain therefore that the admixture occurs after the seed has left the hands of the grower. The small trader is buying all types of native produce and the admixture of other seeds, stones and soil must occur at the buying posts.

SLUDGE AND SCALE.

Two samples have been analysed on behalf of the Kampala Water Supply. One, a grey black sludge, was taken from round about the waterline in the steam drum. Analysis was requested in view of the pitting of the walls. The second was a whitish scale which collected on the fire-bars of the furnace. This seriously reduced the supply of air to the fire and frequent renewal of fire-bars was necessary.

The results of the analyses were:—

	Sludge.	*Scale.*
Silica	16·05 ...	41·75
Iron and Alumina	19·20 ...	20·30
Lime	23·95 ...	21·00
Magnesia	14·15 ...	3·70
Potash	0·98 ...	3·52
Soda	6·75 ...	9·50
Sulphate	trace ...	trace
Chloride	0·12 ...	trace
Carbon Dioxide	18·80 ...	0·23

The main scale-forming matter in the sludge is calcium carbonate which comprises nearly 43% of the total and which under steam pressure would cause pitting The fire-bar deposit is remarkable in its high percentage of silica. The analysis suggests the fusion of the ash around the bars which should not occur if the supply of water in the ash-pan is maintained.

COFFEE MOISTURE.

As a result of the work mentioned in last year's report (p. 75) on the relation between the moisture-content and borer-attack, Uganda coffee was allowed on the Nairobi market provided that it carried a certificate to the effect that the moisture-content was under 12·5%. A number of samples have been tested, being dried for 48 hours at 100°C and only one has been rejected.

DENATURED ALCOHOL.

One sample of alcohol was examined at the instance of the Commissioner of Customs to see if it had been properly denatured according to the Industrial Alcohol Ordinance, and a report was sent to those concerned.

Field Experiments.

In Toro, the manurial experiments with artificials have been continued at three centres with the treatments:—*

A.	Niciphos	240 lbs. per acre.
B.	Superphosphate	2 cwts. ,, ,,
C.	Sulphate of Potash	2 ,, ,, ,,
D.	Sulphate of Potash	2 ,, ,, ,,
	Niciphos	240 lbs. ,, ,,
E.	Sulphate of Potash	2 cwts. ,, ,,
	Superphosphate	2 ,, ,, ,,
F.	No treatment.	

A five-year period will be completed when the 1934 yields become available and the statistical analysis of the yields will be given next year. This year the Niciphos has given significantly better results than the other treatments.

ADDITIONAL FIELD EXPERIMENTS.

A. As already stated Niciphos has given better results than other treatments in Toro. As the soil is acid this might be explained on the fact that Niciphos is an alkaline phosphate whilst Superphosphate is acid so that the latter might revert to an insoluble iron phosphate more quickly than the former. Alternatively the added effect of the Niciphos might be due to its nitrogen content. To test this an experiment has been started in which a heavy dressing of lime is applied annually to one series of Superphosphate plots. The treatments on a 7 by 7 Latin square are:—

A.	Lime	3 tons per acre.
	Superphosphate	2 cwts. ,, ,,
B.	Ammonium Sulphate	175 lbs. ,, ,,
C.	Superphosphate	2 cwts. ,, ,,
D.	Meraco bone meal	4½ ,, ,, ,,
	Ammonium Sulphate	½ ,, ,, ,,
E.	Lime	3 tons ,, ,,
F.	Niciphos	240 lbs. ,, ,,
G.	No treatment.	

B. Comparison of local fertilising materials with Niciphos. A 6 by 6 Latin square with the following treatments:—

A.	Cotton seed	3 tons per acre.
B.	No treatment.	
C.	Meraco bone meal	10 cwts. per acre.
D.	Green manure. Sunn hemp.	
E.	Mulch.	
F.	Niciphos	240 lbs. per acre.

C. An experiment has been designed to compare the effects of complete mulching against those of alternate line mulching as by the latter method the costs of application per acre would be halved. A 5 by 5 Latin square with the following treatments:—

A. Complete mulching with long grass.
B. Alternate line mulching with chaffed grass.
C. No treatment.
D. Complete mulching with chaffed grass.
E. Alternate line mulching with long grass.

D. In Uganda the first quality cotton seed usually pays to export when a ginnery is anywhere near a railway, whilst the second quality or fifi seed may be obtained for very little more than the bagging and transport charges. Analyses of one sample of each gave the following results:—

	Ash %	Phosphoric Acid %	Nitrogen %	Potash %
1st quality seed (safi)	4·5	1·35	2·37	1·23
2nd ,, ,, (fifi)	8·3	1·42	0·82	1·44

*Annual Report, Dept. of Agric., Part II, 1932, p. 76.

A field trial has been laid out comparing the two treatments and combining with them a time of mulching trial. From the points of view of density of grass and conservation of water the grass is best applied at the end of the year when the grass is full grown and the dry season is about to set in. On the other hand a short dry season of about two months is usually experienced in July and August when the trees are bearing crop. A mulch applied in December assists the trees through the long dry season whilst the June mulch would help the trees to carry and ripen the crop. Thus the June and December mulching plots have been included in the safi-fifi experiment giving a 5 by 5 Latin square with the following treatments:—

A. Fifi cotton seed two tons per acre.
B. Elephant grass mulch in June.
C. Elephant grass mulch in December.
D. No treatment.
E. Safi cotton seed two tons per acre.

In all the above experiments individual plot yields were taken for one year, before the application of treatments, as a uniformity trial, so that the yield data from the treatments may be analysed by the method of co-variance.

E. A combined laboratory and field experiment has been started in conjunction with the Assistant Botanist to test the effects of ground treatments on the moisture, temperature and nitrate content of the soil and on the root and shoot growth of coffee.

Five plots of coffee under the following treatments are under observation—

Robusta (*a*) Clean weeded.
Robusta (*b*) Cover crop.
Robusta (*c*) Weeds slashed.
Robusta (*d*) Elephant grass mulch.
Arabica (*e*) Under shade but clean weeded.

Daily records of rainfall, temperature and relative humidity are kept. The plots are sampled at 14-day intervals for moisture and nitrate determinations. The indications up to the present are that, mulched plots are always more moist than under any other treatment, and that nitrate nitrogen under the mulch is lower than under the other treatments.

F. To test the relative soil regenerative powers of elephant grass and a leguminous cover crop some land on the Kampala Plantation which has been cropped continuously for over twenty years was divided into four plots, two being planted with elephant grass and two sown with *Centrosema pubescens*. The plots are being sampled fortnightly for moisture and nitrate nitrogen content. In addition at the beginning and end of the experiment determinations of available phosphate and potash and organic matter will be carried out. Finally the whole experiment will be planted to cotton as an index crop.

G. *Serere Soil Erosion*.—The soil erosion experiment at Serere described in the Annual Report for 1930 yielded results of no statistical significance up to 1933. The yields of cotton in the 1933-34 season show a significant increase in yield from the lowest sections of all treatments. This would appear to indicate that none of the anti-erosion measures has been completely effective. As the experiment has only been running three years it would be premature to draw any conclusions. The plots with lemon grass contour hedges are obviously holding up most of the soil and forming natural terraces. The other treatments do not appear to be as effective. Plans for further work on the soil erosion problem are under consideration.

W. S. MARTIN,
Agricultural Chemist.

ANNUAL REPORT ON THE GOVERNMENT PLANTATION, KAMPALA, FOR THE YEAR 1933.

Weather.

The total rainfall during the year was 43·41 inches, being a decrease of 3·18 inches from last year's figure. This represents a decrease of 6·00 inches below the average for the last 23 years.

Crops.

COFFEE.

Plot No. 3.—Arabica Pruning Experiment.

Object.—To compare the yields obtained from trees pruned on the following systems :—

(i) Single Stem ; (ii) Agobiada ; (iii) Multiple Stem.

Lay-out.—One acre divided into twenty plots under shade (*Pithecolobium Saman*).

The results of this experiment during the last seven years indicate that the highest yields are obtained from the trees pruned on the Agobiada System. The total weights of cherry picked since 1927 are as follows :—

(i)	Agobiada	3843·01 lbs.	
(ii)	Multiple Stem	3412·70	„
(iii)	Single Stem	2779·61	„

Plot No. 4.—Robusta Selections and Pruning Experiment.

Robusta selections planted out in 1930 spaced 8 feet by 8 feet. In 1931 a pruning experiment was started.

Object.—To compare the yields obtained from trees pruned on the following systems :—

(i) Single Stem.
(ii) Agobiada.
(iii) Costa Rica Multiple Stem.
(iv) Modified Costa Rica Method.
(v) Free or Open Multiple Stem.
(vi) Kinawa.

Lay-out.—The pruning systems run in lines across the selection rows, and each method of pruning is demonstrated on four separate rows. Total area, just under one acre. No shade. The trees came into bearing in 1932 and individual tree yields have been kept. The highest yields, so far, have been obtained from the Agobiada and Single Stem methods respectively.

Plot No. 24.—Coffee Planting Experiment.

Object.—The object of this experiment is to test the value of a number of methods of planting coffee, with reference to the subsequent growth of the plants and to the incidence of insect pests. Commenced 1931-32.

Details of lay-out and of methods of planting are given in the Annual Report for 1932, Part II, page 79.

It is as yet too early to obtain any results from this experiment except in connection with Treatment A—seed sown at stake. Very few of these seeds even germinated and such as did germinate were not able to survive long. There are, therefore, no plants in the experiment which have been obtained from seed sown at stake. In order to fill up the blanks caused by the complete failure of Treatment A and the partial failure of other planting methods, extra seedlings from other treatments were planted out in September, 1932. In October, 1933, it was noted that there were still 87 blanks in the plot so these were filled in with one-year-old transplanted seedlings. These were not obtained from the original seed supply, neither is it intended that these 87 seedlings should enter directly into the experiment. They were all planted in the same way, *i.e.*, by using Plantoirs, and the reason for planting them was to overcome the effect of adjoining blanks on the established coffee trees.

The first crop was picked from a few of the trees in October, 1933. Individual tree yields are being kept and the Agricultural Chemist is recording the weights of cherry, parchment and clean coffee. The Government Entomologist has taken detailed notes on the condition of the trees from time to time.

Other Coffee Plots.

Since the selected Robusta plants in Plot No. 4 have started to bear a crop, much of this seed is now being used for general distribution and for planting in the nursery beds. Previously the seed from the No. 9 Selection Plot was used exclusively for this purpose.

A few specimens of the following varieties of coffee were planted out in March :— Stenophylla, Maragogipe and a local " wild " coffee.

Light pruning has taken place on all the coffee plots throughout the year. Elephant grass mulches were applied to Plots Nos. 4 and 7A during the dry season and green manure crops have been planted and dug in at intervals.

GRAFTED CITRUS TREES.

The following grafted Citrus trees were planted out in Plot No. 15 :—

2 Tahitian Lime.
2 East Indian Lime.
2 West Indian Lime.
2 Common Lemon.
1 Lisbon Lemon.
1 Villa Franca Lemon.
1 Jaffa Orange.
1 Blood Orange.
1 Seville Orange.
1 Mediterranean Sweet Orange.
1 Natsu Miparu Grape-fruit.
1 Jacob's Improved Thorny Tangerine.

These trees were received by the Assistant Botanist, Kampala, from Australia and were planted out in April. Plot No. 15 is now fully planted up with grafted Citrus trees, having been started in 1929 with trees from South Africa and Jamaica. A cover of *Centrosema pubescens* which was put down in 1929 was turned under during the year, and an elephant grass mulch applied during the dry weather in December.

PECAN NUT (*Carya pecan*).

Grafted pecan trees were received by the Assistant Botanist, Kampala, in 1932 and planted temporarily near the nursery beds. Four of these were planted out during the rains in the fruit plot, the remainder being sent to Bukalasa and Entebbe.

HYDNOCARPUS WIGHTIANA. (*Plot No. 19*).

Individual tree yields have again been kept with a view to future selection of high yielding trees.

HYDNOCARPUS ANTHELMINTICA. (*Plot No. 11A*).

This plot contains a small number of Hydnocarpus anthelmintica trees which were planted out in 1929. No fruits have yet been produced but the trees have developed well and attained a height of about 16 feet.

TEA. (*Plot No. 32*).

The Assam Indigenous tea growing in this plot was planted in 1911, the seed having been received from India. Previously, all the plants were used for plucking purposes but in 1931 some of the trees were turned into seed-bearers. During the year the Assistant Botanist thinned out a number of the inferior trees. The area under seed bearers is just under half an acre and the plucking bushes comprise about 1/6th of an acre. These bushes were heavily pruned in July and the whole plot mulched with elephant grass in December.

ESSENTIAL OIL PLANTS.

The following essential oil plants were grown on the plantation during the year :—

Pelargonium spp., *Lippia citriodora*, *Mentha* spp., *Pogostemon patchouly*; *Polianthes tuberosa*; *Thymus vulgaris*; *Ocimum* spp., *Coleus* spp., and *Rosmarinus officinalis*.

SUGAR CANE.

The following new cane varieties were received from Natal and have been planted out :—

C.O. 281	P.O.J. 2946
C.O. 290	P.O.J. 2947
P.O.J. 2822	P.O.J. 2952

The sets of P.O.J. 2803, which were also received from Natal, did not survive.

A few plants of P.O.J. 2878, P.O.J. 2725 and P.O.J. 2727 are being kept on the plantation in case a further supply of these should be needed in the future.

FIBRES.

Small plots of *Boehmeria nivea* (Ramie), Jute, *Asclepias semilunata*, and *Crotalaria juncea* have been maintained throughout the year.

NURSERY.

The usual routine work has been carried on in the nursery, consisting chiefly of the raising of coffee plants and fruit trees for distribution purposes.

The following plants and seeds were distributed during the year :—

	Coffea robusta.		*Coffea arabica.*		*Various economic*	
	Plants.	Seeds.	Plants.	Seeds.	Plants.	Seeds.
To Natives	23,555	—	26,773	—	100	—
School Garden	1,161	—	138	—	389	41 lbs.
Officials	770	184 lbs.	—	—	1,777	—
Others	3,200	16 „	1,000	—	1,181	—

	Cover Crop and Green Manure.	*Tea Seed.*	*Decorative* Plants.	*Decorative* Seeds.	*Lemon grass, roots.*
To Natives	7½ lbs.	—	—	—	—
School Gardens ...	63 „	—	10	—	1,000
Officials	196 „	—	30	11 lbs.	1,000
Others	25 „	112 lbs.	273	—	—

R. W. STUCKEY,

Agricultural Officer, Education.